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Effects of Beach Nourishment on the Nearshore Environment in Lake Huron at Lexington Harbor (Michigan)

by

Robert T. Nester and Thomas P. Poe

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In October 1980 the U.S. Army Corps of Engineers conducted a beach nourishment project at the Lexington (Michigan) Harbor on the southwest shore of Lake Huron, a project designed to mitigate beach erosion attributable to the installation of the harbor. In response to a request from the Coastal Engineering Research Center (CERC), the U.S. Fish and Wildlife Service's Great Lakes Fishery Laboratory conducted a Corps-funded study from June 1980 to October 1981 along a 8.4-kilometer segment of shoreline adjacent to the harbor to determine the effect

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) of the Corps' beach nourishment project on the nearshore aquatic environment. The study performed by the service included aerial photographic surveys of the study area; measurements of dissolved oxygen, turbidity, and suspended particulate matter levels; and collection of lake bottom sediments, macrozoobenthos and fish.

Analysis of the aerial photographs showed that the beach face profile changed markedly during the study as a result of beach nourishment. Dredging of about 19,000 cubic meters of beach sediment from an accretion area adjacent to the harbor's north breakwater caused the beach face to recede, while deposition of this sediment on a feeder beach south of the harbor caused the beach face there to extend lakeward. Deposition on a second feeder beach south of the harbor of about 35,000 cubic meters of sediment from a land borrow site caused the beach face at the second feeder beach to extend lakeward. One year after the beach nourishment project was completed the beach face in the accretion area had returned to its predredged location, while the beach face south of the harbor still occupied a position similar to that observed at the completion of the beach nourishment project in October 1981. Analysis of the other data collected revealed no change in the particle-size distribution of the bottom sediments, the water quality, or the distribution and abundance of macrozoobenthos and fish in the study area that could be attributed to the Corps' beach nourishment project. It is concluded, therefore, that the beach nourishment project conducted at Lexington Harbor in October 1980 had no significant adverse impact on the nearshore aquatic environment in the study area.

PREFACE

This report provides coastal engineers the results of a study conducted by U.S. Fish and Wildlife Service's Great Lakes Fishery Laboratory on the effect of beach nourishment activities on the nearshore aquatic environment in the vicinity of Lexington Harbor. The work was carried out under the U.S. Army Coastal Engineering Research Center's (CERC) Foredune Ecology work unit, Environmental Impact Program, Coastal Engineering Area of Civil Works Research and Development.

The report was prepared by Robert T. Nester and Thomas P. Poe, Research Fishery Geologists, U.S. Fish and Wildlife Service, Ann Arbor, Michigan, under CERC agreement No. W74RCV CERC 80-45. The authors acknowledge E.J. Pullen, T.A. Edsall, D. Les, C. Mousigian, F. Koehler, W. Porak, J. French, III, and R. Sayers, Jr., for their advice and assistance.

E.J. Pullen, Chief, Coastal Ecology Branch, served as contract monitor for this report, under the general supervision of Mr. R.P. Savage, Chief, Research Division.

Technical Director of CERC was Dr. Robert W. Whalin, P.E., upon publication of the report.

Comments on this publication are invited.

Approved for publication in accordance with Public Law 166, 79th Congress, approved 31 July 1945, as supplemented by Public Law 172, 88th Congress, approved 7 November 1963.

TED E. BISHOP
Colonel, Corps of Engineers
Commander and Director

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FIGURES

CONVERSION FACTORS, U.S. CUSTOMARY TO METRIC (SI) UNITS OF MEASUREMENT

U.S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	by	To obtain
inches	25.4	millimeters
	2.54	centimeters
square inches	6.452	square centimeters
cubic inches	16.39	cubic centimeters
feet	30.48	centimeters
	0.3048	meters
square feet	0.0929	square meters
cubic feet	0.0283	cubic meters
yards	0.9144	meters
square yards	0.836	square meters
cubic yards	0.7646	cubic meters
miles	1.6093	kilometers
square miles	259.0	hectares
knots	1.852	kilometers per hour
acres	0.4047	hectares
foot-pounds	1.3558	newton meters
millibars	1.0197×10^{-3}	kilograms per square centimeter
ounces	28.35	grams
pounds	453.6	grams
	0.4536	kilograms
ton, long	1.0160	metric tons
ton, short	0.9072	metric tons
degrees (angle)	0.01745	radians
Fahrenheit degrees	5/9	Celsius degrees or Kelvins[1]

[1]To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use formula: $C = (5/9)(F - 32)$.

To obtain Kelvin (K) readings, use formula: $K = (5/9)(F - 32) + 273.15$.

EFFECTS OF BEACH NOURISHMENT ON THE NEARSHORE ENVIRONMENT IN LAKE HURON AT LEXINGTON HARBOR (MICHIGAN)

by

Robert T. Nester
and
Thomas P. Poe

I. INTRODUCTION

The U.S. Army Corps of Engineers conducted a beach nourishment project at the Lexington Harbor at Lexington, Michigan, on the southwest shore of Lake Huron in October 1980 (Fig. 1). The project was designed to mitigate shoreline erosion attributable to the installation of the harbor which interrupted the littoral drift of beach sediments and accelerated erosion of the shoreline south of the harbor. Nourishment was accomplished by establishing a feeder beach on the lake foreshore immediately south of the harbor in the area of heaviest erosion. About 54,000 cubic meters of sediment was deposited to create the feeder beach. About 19,000 cubic meters of this sediment was dredged from an accretion area at the shoreward end at the harbor's north breakwater and pumped to the beach; the remainder was obtained from a nearby commercial borrow site on land and trucked to the beach. In response to a request from the U.S. Army Coastal Engineering Research Center (CERC), the U.S. Fish and Wildlife Service's Great Lakes Fishery Laboratory conducted a study to determine the effect of the beach nourishment activities on the nearshore aquatic environment in the vicinity of the harbor. Although the effects of beach nourishment activities on the ecology of marine coastal areas have received considerable attention in recent years (Cronin, Gunter, and Hopkins, 1971; Courtenay, et al., 1974; Parr, Diener, and Lacy, 1978; Marsh, et al., 1978, 1980; Culter and Mahadevan, 1982), the present report represents the first effort to identify and evaluate such effects in a Great Lakes coastal area.

II. METHODS AND MATERIALS

1. Beach Face Profile.

A number of aerial photographs were taken throughout the study area, and in particular in the Corps' beach nourishment project area immediately adjacent to the harbor, to describe the beach face profile. Figure 1 is an oblique view of the harbor on 3 December 1980 from an altitude of about 450 meters. Figure 2 is an overlapping series of aerial photographs taken of the shoreline of the entire study area on 16 June 1980 from an altitude of about 1,800 meters. This figure shows both the location of the transects with sampling stations and the beach face profile of the study area. Figures 3, 4, and 5 are aerial photographs taken of the harbor area on 16 June 1980, 3 December 1980, and 6 December 1981 from an altitude of about 450 meters showing changes in the beach face profile in the area where the nourishment activity occurred.

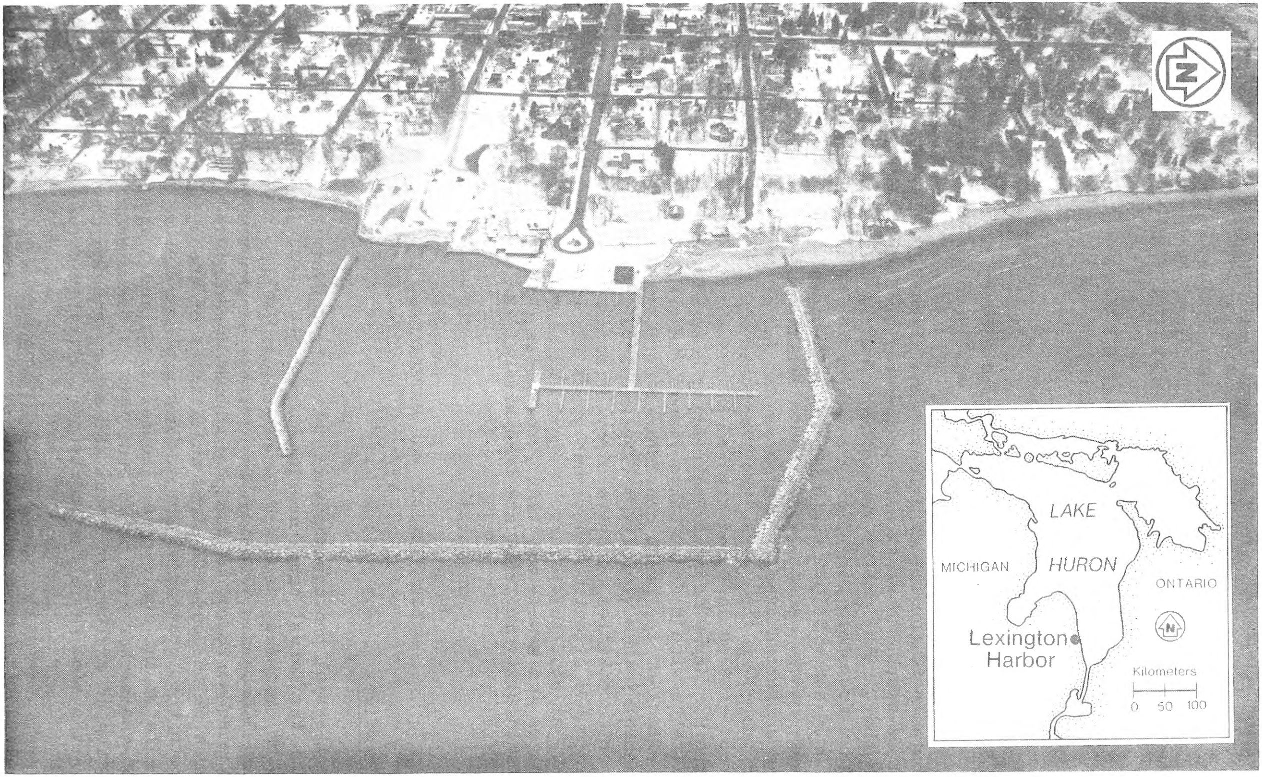

Figure 1. Lexington Harbor, 3 December 1980.

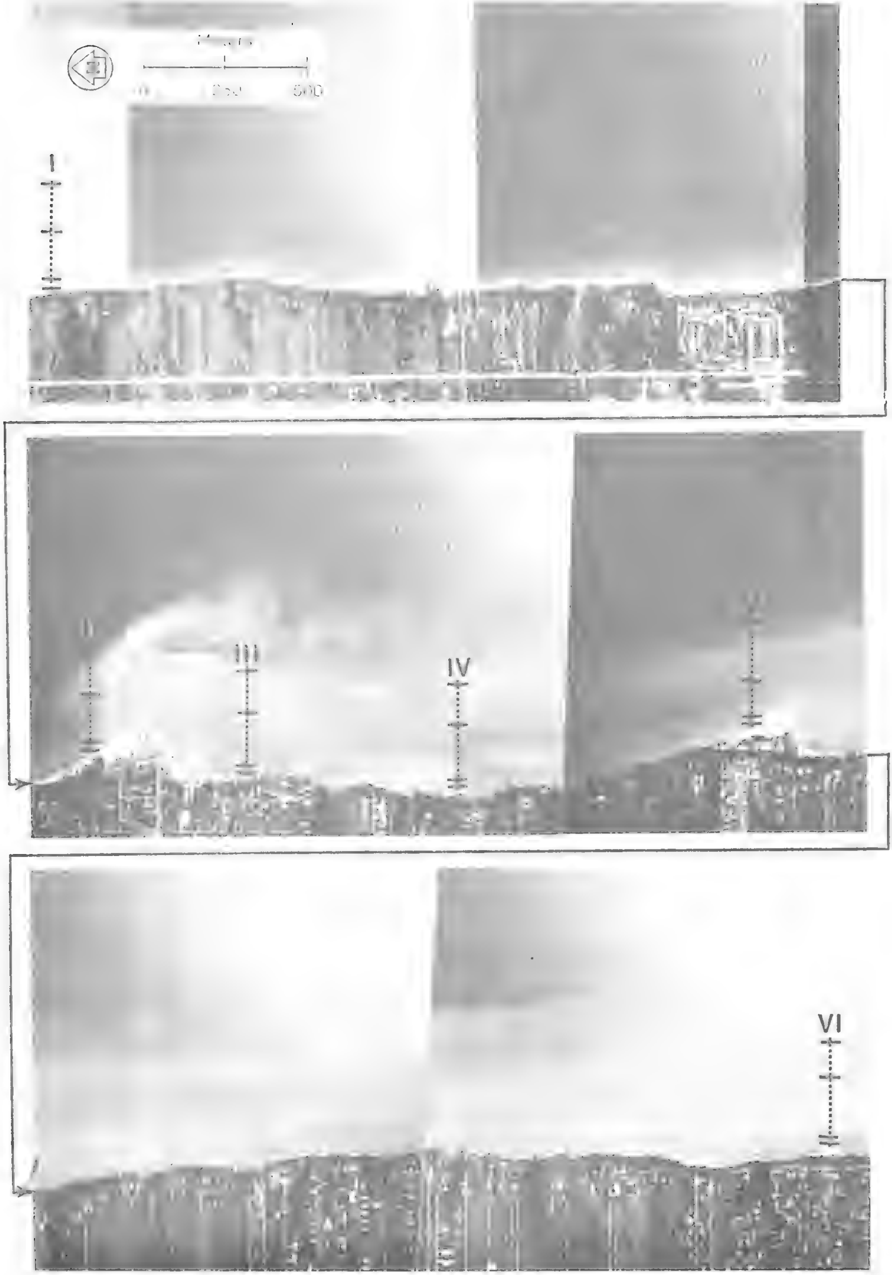

Figure 2. The study area with transects and sampling stations indicated.

Figure 3. Lexington Harbor, 16 June 1980. A is the accretion area at shoreward end of north breakwall; B and C indicate erosion along the shoreline south of harbor.

Figure 4. Lexington Harbor, 3 December 1980. A is the accretion area 2 months after removal of about 19,000 cubic meters of beach sediment; B is the part of the beach that received the 19,000 cubic meters of beach sediment from the accretion area; and C is the part of the feeder beach 2 months after receiving about 35,000 cubic meters of sediment from a nearby land borrow site.

Figure 5. Lexington Harbor, 6 December 1981. A is the accretion area 14 months after removal of about 19,000 cubic meters of beach sediment; B is the part of the feeder beach that received the 19,000 cubic meters of beach sediment from the accretion area; C is the part of the feeder beach 14 months after receiving about 35,000 cubic meters of sediment from a nearby land borrow site.

2. Sampling Locations.

Sampling was conducted at four stations located on each of six transects that were established perpendicular to the shoreline in the vicinity of the Lexington Harbor (Fig. 2). Transects I and VI were located respectively north and south of the harbor in reference areas outside the immediate influence of the beach nourishment activities; transect II was located immediately north of the harbor in a beach sediment accretion area created by the installation of the harbor's north breakwater; and transects III, IV, and V were located south of the harbor in the area subject to the heaviest erosion. Permanent structures on land (e.g., buildings) were used as reference points to fix the location of each transect. The four stations on each transect were located as follows: station 1 was established on the 0.5-meter depth contour in the zone of potentially heaviest surf action within 3 to 6 meters of the shoreline; station 2 was on the 2-meter depth contour just lakeward of the zone of heaviest surf action about 90 meters offshore; station 3 was on the 4-meter depth contour about 240 meters offshore; and station 4 was on the 5-meter depth contour about 460 meters offshore.

3. Sampling Periods.

Sampling was conducted at all stations on 9 to 13 June, 21 to 25 July, and 14 to 21 October 1980 and on 8 to 11 June, 13 to 16 July, and 5 October to 13 November 1981. The October 1981 sampling period was extended by a series of fall storms which began on 9 October and prevented sampling with the beach seine until 12 and 13 November. The June and July 1980 sampling periods were chosen to document conditions in the study area before the beach nourishment project was conducted in early October 1980. The October 1980 sampling period was chosen to describe conditions immediately after the beach nourishment project was completed. Sampling in 1981 was designed to document the changes and the level of recovery that occurred in the 8 to 12 months following completion of the beach nourishment project.

4. Substrate.

To characterize the substrate throughout the study area, the lake bottom at each station was observed from the vessel deck whenever conditions permitted. The lake bottom was also observed at several locations in the study area using an underwater television system (Video Sciences Incorporated, Model 400495).

Samples of sediment to be used for particle-size determinations were collected with a Ponar grab. One grab sample was taken at each of the stations during each of the sampling periods; a total of 144 samples were taken. In the laboratory the sediment in each sample was separated into five fractions following the techniques for dry sieving in the IBP Handbook No. 16 (Buckhanan, 1971). These fractions were fine gravel, 8 to 2 millimeters in diameter (retained by a No. 10 sieve); course sand, 2 to 0.5 millimeter in diameter (retained by a No. 35 sieve); medium sand, 0.5 to 0.25 millimeter in diameter (retained by a No. 60 sieve); fine sand, 0.25 to 0.125 millimeter in diameter (retained by a No. 120 sieve); and very fine sand, 0.125 to 0.062 millimeter in diameter (retained by a No. 230 sieve). Only fractions smaller than 8 millimeters in diameter and larger than 0.062 millimeter in diameter were retained for analysis.

The sediment size data were analyzed using Friedman's test (after Zar, 1974), a nonparametric test which requires only ordinal scaling of data. This test was used to evaluate (1) differences in relative particle size distribution among all six transects (data for all four stations on each transect were combined for analysis) within each sampling period; and (2) differences in relative particle-size distribution at station 1 among all six transects within each sampling period. The percent composition values were ranked within each particle-size category, and the ranked values were summed for each transect to calculate:

$$X_r^2 = \frac{12}{ba(a + 1)} \sum_{i=1}^{a} R_i^2 - 3b(a + 1)$$

where a is the number of treatments (columns), b the number of blocks, and R_i^2 the sum of the ranks squared in each column. Critical table values for combinations of a and b were found in Zar (1974).

5. Water Quality.

At the surface of station 1 and at the surface and bottom of stations 2, 3, and 4 on each transect during each sampling period, water temperature and dissolved oxygen concentration were measured with a YS1 Model 51B meter and water samples to be used for determination of turbidity and suspended solids were collected with a Van Dorn bottle. The samples were iced and stored in an insulated container for analysis in the laboratory. Turbidity was measured with an H F Instruments Ltd. Turbidimeter, Model 1000. The weights of suspended solids were determined by filtering a known volume of each sample under vacuum on a tared Whatman glass-fiber filter paper, drying the filter paper at 40° Celsius for 24 hours and weighing the tared paper.

6. Macrozoobenthos.

Macrozoobenthos samples were collected with a Ponar grab. Three grab samples were collected at each station during each of the six sampling periods. Previous macrozoobenthos studies (Schuytema and Powers, 1966) in the nearshore waters of Lake Huron have indicated that three replicate grabs make up an adequate sample. Each grab sample was washed through a standard No. 30 sieve (0.65-millimeter mesh size), and the benthic invertebrates (macrozoobenthos) retained by the screen were placed in a labeled container, preserved in 10 percent formalin, and taken to the laboratory for processing. Organisms were identified to the lowest practical taxonomic level (e.g., family, genus, or species) and the criteria for assigning individuals to each such taxon were unchanged throughout the study. Although grab sample volume varied, the number of organisms per replicate grab remained relatively constant indicating that most of the organisms were probably confined to the upper few centimeters of the substrate.

Macrozoobenthos communities at each station were compared before and after beach nourishment using Morisita's index of community similarity as modified by Horn (1966). This index provides a measure of the probability that individuals randomly drawn from each of the two communities will belong to the same species, relative to the probability of randomly selecting two individuals of the same species from one of the communities. Morisita's index values ($C\lambda$) were calculated as follows:

$$C\lambda = \frac{2\sum_{i=1}^{s}(a_i)(b_i)}{A \cdot B\left(\frac{\sum_{i=1}^{s} a_i^2}{A^2} + \frac{\sum_{i=1}^{s} b_i^2}{B^2}\right)}$$

where A and B are the total number of individuals in samples from communities 1 and 2, respectively, and a_i and b_i are the number of individuals in each species present in samples from communities 1 and 2, respectively. $C\lambda$ varies from zero when the communities are completely distinct (containing no species in common) to unity when the communities are identical in proportional species composition.

In comparing the communities, the values of $C\lambda$ were considered to indicate the following: values below 0.500 indicated the communities were dissimilar; values from 0.500 through 0.749 indicated that the communities were similar; and values from 0.750 through 0.99 indicated that the communities were highly similar.

7. Fish.

Fish were sampled with a 46-meter-long, 2.4-meter-deep beach seine (0.6-centimeter mesh, stretched measure) and 43-meter-long, 1.8-meter-deep graded mesh gillnets, each constructed of seven 6-meter-long panels of gillnet mesh (one panel each of 2.5-, 3.8-, 5.1-, 6.3-, 7.6-, 10.1-, and 12.7-centimeter mesh, stretched measure) joined end-to-end. One seine haul was made at night at station 1 on transects I, IV, and VI during each sampling period. The seine haul was accomplished by anchoring one end of the net on the beach, setting the remainder of the net by boat in a semicircle extending from the beach out into the lake and back to the beach, and then pulling the entire net onto the beach. One gillnet was set overnight, perpendicular to the shoreline at stations 3 and 4 on transects I, IV, and VI. All fish collected in seines and gillnets were identified, weighed to the nearest gram, and measured to the nearest millimeter.

The fish sampling was designed to indicate the changes in the abundance of the major commercial, sport, and forage fish species throughout the study area that might have occurred as a result of the beach nourishment activities. Fish catch data were compared among transects.

III. RESULTS

1. Beach Face Profile.

Aerial photographs of the shoreline in the vicinity of the Lexington Harbor (Figs. 3 to 5) show that the beach face profile changed markedly during the study. On 16 June 1980 the beach face in area A (accretion area) was located about 15 meters lakeward of the west end of the harbor's north breakwater (Fig. 3); the beach in this area, as measured to the tree line, was about 90 meters wide. In areas B and C the beach face was located within 15 meters of the tree line except at the north end of area B where the maximum width of the beach was about 30 meters. Several groins, piers, and docks, some extending 15 meters or more into the lake beyond the beach face, were visible in areas B and C.

On 3 December 1980, 2 months after nourishment the beach face in area A was located at the base of the harbor's north breakwater, about 30 meters landward of the position occupied on 16 June 1980 (Figs. 3 and 4). The beach face in areas B and C (nourished beach) on 3 December 1980, however, was located about 15 to 45 meters lakeward of the position occupied on 16 June 1980, which resulted in the groins, piers, and docks being behind (landward of) the beach face (Fig. 4).

On 6 December 1981, 14 months after nourishment, the beach face in area A was located at the west end of the harbor's north breakwater, about 30 meters lakeward of the position occupied on 16 June 1980 and about 45 meters lakeward of the position occupied on 3 December 1980 (Figs 3, 4, and 5). The width of the beach on 6 December 1981, as measured to the tree line was about 120 meters. At the northern end of area B the beach face was located about 15 meters lakeward of the position occupied on 3 December 1980, while at the southern end of area B the beach face retreated landward about 7 meters. In some parts of area C the beach face was located about 30 meters landward of the position occupied on 3 December 1980.

2. Substrate.

The 144 Ponar grab samples collected in June, July, and October 1980 and 1981, together with observations of the substrate (in situ) made from the vessel deck and with an underwater television camera, revealed that the substrate in the study area ranged from silty clay to large boulders (App. A). The substrate on all transects was generally cobble mixed with coarse sand and fine gravel at stations 1 and 2, and was mostly cobble with isolated pockets of sand and fine sand at stations 3 and 4. The one exception occurred on transect III at stations 2 and 3 where inspection of the sediment samples, as they were removed from the grab, revealed the presence of pockets of silty clay on a predominantly cobble bottom. Boulders as large as 2.5 meters in diameter were distributed irregularly throughout the study area. A remotely operated underwater television camera was used to obtain permanent videotape records of the substrate at each station to describe the composition of the substrate components that were too large to sample effectively with the Ponar grab. However, sea conditions, low water clarity, and equipment failure prevented the completion of the required videotape recordings.

Grab sample size varied widely throughout the study reflecting mainly the effectiveness of the Ponar grab on the different substrates encountered. However, the samples obtained provided an adequate representation of the fine gravel-very fine sand component of the substrate in the areas sampled (App. A). The fine and medium sand fractions collectively accounted for 79 to 85 percent of the total (by weight) in each of the sampling periods during both years, the very fine sand fraction accounted for 11 to 14 percent, and coarse sand and fine gravel together accounted for 1 to 10 percent (Table 1). Friedman's test was used to determine if there were significant ($P \leq 0.05$) differences in particle-size distribution of the sand-gravel component of the substrate at station 1 in all six transects (Table 2) and at stations 1 to 4 combined among all six transects (Table 3) within each of the six sampling periods. No significant differences were found.

Table 1. Percentage composition by weight of the fine gravel-very fine sand substrate fractions in Ponar grab samples.

Sampling period	Fine gravel (8.0-2.0mm)	Coarse sand (2.0-0.5mm)	Medium sand (0.5-0.25mm)	Fine sand (0.25-0.125mm)	Very fine [illegible] (0.125-0.062mm)
1980					
9 June	1.8	4.0	29.7	53.4	11.1
21 July	4.9	4.7	25.0	53.7	11.7
14 October	1.9	3.2	20.0	63.5	11.4
1981					
10 June	2.7	3.3	21.6	61.8	10.6
14 July	0.4	0.9	18.8	66.6	13.3
8 October	0.8	1.7	17.6	65.8	14.1

Table 2. Results of Friedman's test comparing particle-size distribution among grab samples taken at station 1 on transects I to VI.

Sampling date	Degrees of freedom	X_r^2	Minimum level of Significance
1980			
9 June	5	4.383	0.50
21 July	5	1.419	0.95
14 October	5	2.103	0.90
1981			
10 June	5	0.336	0.999
14 July	5	3.813	0.75
8 October	5	0.621	0.99

Table 3. Results of Friedman's test comparing particle-size distribution among grab samples taken at stations 1 to 4 combined on transects I to VI.

Sampling date	Degrees of freedom	X_r^2	Minimum level of Significance
1980			
9 June	5	1.989	0.90
21 July	5	3.471	0.75
14 October	5	1.875	0.90
1981			
10 June	5	1.562	0.95
14 July	5	3.813	0.75
8 October	5	4.497	0.50

3. Water Quality.

Water temperature was relatively constant throughout the study area within each sampling period in both years (App. B). Temperatures ranged from 10.0° to 21.0° Celsius in 1980, and from 10.9° to 23.8° Celsius in 1981. In both years the highest temperature was recorded in July and the lowest in October. Generally the water temperature was slightly higher at stations 1 and 2 than at stations 3 and 4, and was also slightly higher at the surface than at the bottom. Dissolved oxygen (DO) remained at or near 100 percent saturation at all stations throughout the study (App. B). Concentrations of DO ranged from 9.4 to 13.2 milligrams per liter in July and June 1980, respectively, and from 8.4 to 12.9 milligrams per liter in July and June 1981, respectively. Throughout the study suspended particulate matter (SPM) was highest at station 1 and decreased with distance from shore; SPM ranged from 1.2 to 133.6 milligrams per liter in July 1980 and from 1.7 to 145.0 milligrams per liter in June and October 1981, respectively (App. B). At stations 3 and 4 SPM was usually higher at the bottom than at the surface. Throughout the study, turbidity was usually higher at stations 1 and 2 than at stations 3 and 4; turbidity ranged from 1.1 to 81.0 nelphalometric turbidity units (NTU) in July 1980 and from 0.6 to 70.5 NTU in June to October 1981, respectively (App. B).

Turbidity values were also similar on all transects within each sampling period. The single exception occurred on 21 July 1980, when turbidity values were low on transect I and high on transects II through VI (App. B). A similar situation is apparently documented in an aerial photograph of the harbor area taken on 23 July 1980 (Fig. 2).

4. Macrozoobenthos.

More than 29,600 organisms representing 40 taxa were identified from the 432 benthos samples taken throughout the study (Table 4; App. C). The most abundant organisms were Oligochaeta (worms) and Chironomidae (midge larvae) which made up 71 and 21 percent, respectively, of the total by number; 17 other taxa made up 2.0 to 0.1 percent of the total and the remaining 21 taxa contributed less than 0.1 percent each.

The densities of oligochaetes at all transects and for all sampling periods were usually lowest at station 1 and highest at either station 3 or 4 (Table 5). One major exception to this trend occurred at transect III, station 2, in October 1980 when the density of oligochaetes reached 10,137 per square meter, greatly exceeding that at stations 3 and 4.

Densities in 1981 were often higher than in 1980 at many transects and stations, and the densities at transect I, station 4, in October 1981 and transect III, station 3, in July and October 1981 were the highest measured during the study. The high density at transect I, a reference transect, is unexplained. The consistently high densities of oligochaetes at transect III in both 1980 and 1981 may reflect the presence of an eddy current just south of the harbor which appeared to cause silty clay to accumulate, thus providing a more suitable substrate than is available elsewhere throughout the study area for colonization by oligochaetes.

The densities of chironomids at all transects for all sampling periods were usually the lowest at station 1 (Table 6). Densities at stations 2 to 4,

Table 4. Taxonomic composition and relative abundance of macrozoobenthos collected by Ponar grab.

Taxon	Pct Composition	Taxon	Pct Composition
Hydra	0.3	*Polycentropus*	0.3
Rhabdocoela	0.7	Leptoceridae	<0.1
Tricladida	0.1	*Oecetis*	0.1
Nematoda	0.7	*Mystacides*	<0.1
Hirudinea	0.1	*Ceraclea*	<0.1
Oligochaeta	71.3	*Hydroptila*	<0.1
Manayunkia speciosa	<0.1	*Molanna*	<0.1
Ostracoda	2.0	*Cheumatopsyche*	<0.1
Gammarus	0.3	Unidentified Trichoptera	<0.1
Pontoporeia hoyi	0.5	Corixidae	0.4
Hyalella azteca	0.2	Plecoptera	<0.1
Argulus	<0.1	Acarina	0.5
Chironomidae	21.3	Ancylidae	<0.1
Ceratopogonidae	<0.1	*Lymnaea*	<0.1
Empididae	<0.1	*Physa*	<0.1
Tipulidae	<0.1	*Gyraulus*	<0.1
Caenis	0.6	*Amnicola*	0.1
Hexagenia	<0.1	Unidentified Gastropoda	<0.1
Stenonema	<0.1	*Pisidium*	0.4
Elmidae	<0.1	Unidentified Sphaeriidae	0.2

Table 5. Density of oligochaetes (average number per square meter).

Transect	Station	1980 June	1980 July	1980 October	1981 June	1981 July	1981 October
I	1	0	7	7	0	34	0
	2	14	510	152	7	131	41
	3	114	2,583	69	34	599	145
	4	1,205	937	2,920	5,916	592	18,174
II	1	0	48	7	0	7	14
	2	14	76	69	0	48	7
	3	875	276	820	0	544	96
	4	117	331	303	103	1,398	1,047
III	1	7	90	152	21	179	28
	2	117	496	10,137	262	1,577	2,707
	3	1,929	3,078	778	3,416	33,393	10,860
	4	331	331	282	303	1,846	792
IV	1	14	0	14	7	310	7
	2	179	482	200	62	90	21
	3	1,343	110	992	523	833	48
	4	131	1,054	186	277	5,061	771
V	1	0	0	28	14	138	0
	2	14	55	21	14	0	0
	3	138	468	517	14	117	69
	4	1,129	1,095	799	537	1,832	4,759
VI	1	34	14	7	0	117	0
	2	0	186	34	0	110	14
	3	220	172	647	193	392	48
	4	792	1,260	730	351	2,492	992

Table 6. Density of chironomids (average number per square meter).

Transect	Station	1980 June	1980 July	1980 October	1981 June	1981 July	1981 October
I	1	7	69	0	21	90	14
	2	55	881	110	41	41	34
	3	196	523	14	337	117	76
	4	627	282	489	2,438	131	1,315
II	1	21	62	0	48	62	0
	2	55	399	145	207	269	227
	3	634	186	96	193	200	275
	4	324	344	48	110	365	227
III	1	14	110	21	55	158	7
	2	303	158	558	1,136	344	496
	3	613	2,679	200	1,522	1,054	503
	4	413	427	34	379	303	1,033
IV	1	90	103	21	131	138	62
	2	399	448	83	165	90	76
	3	2,472	179	262	337	282	165
	4	344	943	76	530	1,591	152
V	1	0	14	7	145	275	21
	2	131	110	55	41	90	14
	3	186	172	213	90	200	110
	4	200	344	152	358	393	386
VI	1	41	207	0	179	110	0
	2	145	69	7	48	110	55
	3	131	179	117	117	365	165
	4	1,853	296	124	854	613	379

however, varied considerably among transects and sampling periods without any pattern. The densities of chironomids generally averaged higher at stations 2 and 3 on transect III than elsewhere probably because of an accumulation of silty clay there which provided a more suitable substrate for colonization by chironomids. Generally the densities of chironomids in June and July were higher than in October at nearly all stations in both years.

Of the 38 other taxa represented in the samples, Ostracoda, Rhabdocoela, Nematoda, Caenis, Pontoporeia hoyi, Acarina, Corixidae, and Pisidium were found frequently; collectively, they made up 5.7 percent of the total macrozoobenthos (Table 4).

Index values ($C\lambda$) obtained by applying Morisita's test of community similarity to the data (Table 7) indicate that the macrozoobenthos communities at station 1 in transects I to VI in 1980 differed in 9 of 18 comparisons from the communities present on these same stations in 1981. At stations 2 to 4, however, the index values indicate that the macrozoobenthos communities in 1980 were either similar or very similar to those in 1981 in 51 of 54 comparisons.

5. Fish.

Almost 12,100 fish representing 31 species were caught in 36 gillnet sets and 18 beach seine hauls during the study (Table 8; Apps. D and E). Gizzard shad (Dorosoma cepedianum) were 52.7 percent of the combined total catch and spottail shiners (Notropis hudsonius), alewives (Alosa pseudoharengus), and troutperch (Percopsis omiscomaycus) were about 10 to 13 percent each of the total; four species contributed about 1 to 7 percent each and the remaining 23 species made up less than 1 percent each. With the exception of the gizzard shad which was taken in large numbers only in 1980, the species that dominated the catch in 1980 were also the most abundant ones taken in 1981. The list of species caught in 1981 differed little from that for 1980; only a few of the least abundant species were added to or lost from the list in 1981.

More fish were caught in both types of gear in 1980 than in 1981 (Table 8). The smaller gillnet catch in 1981 resulted almost entirely from a decrease in the catch at transects I and VI, the reference transects (Table 9). The smaller seine catch in 1981 was due to much lower catches in July and November 1981 than in the corresponding periods in 1980; these decreases in July and November offset the increase over 1980 levels that occurred in the catch in June 1981 on transects IV and VI. The low catch in July 1981 appears to have resulted from a general reduction in the abundance of almost all species (App. E), whereas the low catch in November 1981 reflects only a sharp reduction in the abundance of gizzard shad (Table 10).

IV. DISCUSSION

1. Beach Face Profile.

Changes in the beach face profile that are evident in Figures 3, 4, and 5 reflect the Corps' beach nourishment activities in October 1980, which included the removal of beach sediment from area A, the deposition of that sediment in area B, and the deposition in area C of sediment from a land borrow site; they also reflect the littoral drift of beach sediment during the period of study.

Table 7. Morisita's index values (Cλ) showing the degree of similarity of the macrozoobenthos community by station, between sampling periods.[1]

Transect	Station	June 1980 vs June 1981	July 1980 vs July 1981	October 1980 vs October 1981
I	1	0.444	0.799	0.000
	2	0.981	0.710	0.969
	3	0.901	0.978	0.919
	4	0.985	0.988	0.989
II	1	0.223	0.844	0.632
	2	0.838	0.996	0.895
	3	0.574	0.899	0.426
	4	0.892	0.795	0.994
III	1	0,728	0.973	0.948
	2	0.976	0.994	0.987
	3	0.990	0.733	0.966
	4	0.984	0.720	0.557
IV	1	0.956	0.290	0.228
	2	0.967	0.995	0.602
	3	0.960	0.768	0.511
	4	0.985	0.904	0.971
V	1	0.000	0.457	0.213
	2	0.823	0.843	0.463
	3	0.791	0.768	0.777
	4	0.804	0.988	0.990
VI	4	0.559	0.690	0.000
	2	0.871	0.903	0.411
	3	0.982	0.987	0.962
	4	0.964	0.988	0.961

[1] Values of Cλ below 0.500 indicate communities are dissimilar, values of 0.500-0.749 indicate communities are similar, and values of 0.750-0.999 indicate communities are highly similar.

Table 8. Spe

Table 8. Species composition and relative abundance of fish.

Common name	Scientific name	Gillnet 1980	Gillnet 1981	Beach Seine 1980	Beach Seine 1981	Total by species	Species total as a Pct of total catch
Lake sturgeon	*Acipenser fulvescens*	1	0	0	0	1	<0.1
Alewife	*Alosa pseudoharengus*	565	552	56	244	1,417	11.7
Gizzard shad	*Dorosoma cepedianum*	0	1	6,346	24	6,371	52.7
Rainbow smelt	*Osmerus mordax*	4	17	60	14	95	0.8
Black bullhead	*Ictalurus melas*	1	0	0	0	1	<0.1
Channel catfish	*Ictalurus punctatus*	2	1	0	0	3	<0.1
Burbot	*Lota lota*	1	2	0	0	3	<0.1
Troutperch	*Percopsis omiscomaycus*	168	52	611	378	1,209	10.0
Freshwater drum	*Aplodinotis grunniens*	0	0	1	0	1	<0.1
Round whitefish	*Prosopium cylindraceum*	0	1	0	0	1	<0.1
Chinook salmon	*Oncorhynchus tshawytscha*	1	2	9	32	44	0.4
Rainbow trout	*Salmo gairdneri*	0	0	2	0	2	<0.1
Brown trout	*Salmo trutta*	1	0	0	0	1	<0.1
Lake trout	*Salvelinus namaycush*	50	30	2	0	82	0.1
Coho salmon	*Onchorhynchus kisutch*	0	1	0	0	1	<0.1
Carp	*Cyprinus carpio*	0	0	5	1	6	0.1
White sucker	*Catostomus commersoni*	24	25	6	3	58	0.5
Unidentified redhorse	*Moxostoma* sp.	0	1	0	0	1	<0.1
Emerald shiner	*Notropis atherinoides*	0	0	228	267	495	4.1
Spottail shiner	*Notropis hudsonius*	347	150	752	285	1,534	12.7
Sand shiner	*Notropis stramineus*	0	0	144	27	171	1.4
Bluntnose minnow	*Pimephales notatus*	0	0	0	2	2	<0.1
Fathead minnow	*Pimephales promelas*	0	0	2	0	2	<0.1
Longnose dace	*Rhinichthys cataractae*	0	0	291	14	305	2.5
Rockbass	*Ambloplites rupestris*	0	1	0	1	2	<0.1
Johnny darter	*Etheostoma nigrum*	0	0	1	0	1	<0.1
Logperch	*Percina caprodes*	0	0	9	0	9	0.1
River darter	*Percina shumardi*	0	0	6	0	6	0.1
Yellow perch	*Perca flavescens*	92	81	11	3	187	1.5
Walleye	*Stizostedion vitreum vitreum*	29	33	0	1	63	0.5
Mottled sculpin	*Cottus bairdi*	0	0	16	6	22	0.2
Total catch		1,286	950	8,558	1,302	12,096	100.0

Table 9. Gillnet catches for all species combined.

Transect	1980 June	1980 July	1980 Oct	Total 1980	1981 June	1981 July	1981 Oct	Total 1981
I	271	173	30	474	103	83	23	209
IV	231	96	31	358	277	43	15	335
VI	286	145	23	454	309	81	16	406
Total	788	414	84	1,286	689	207	54	950

Table 10. Beach seine catches for all species combined.

Transect	1980 June	1980 July	1980 Oct	Total 1980	1981 June	1981 July	1981 Nov	Total 1981
I	380	322	2,672[1]	3,374	339	10	25	374
IV	322	402	874[2]	1,598	422	13	17	452
VI	95	325	3,166[3]	3,586	416	40	20	476
Total	797	1,049	6,712	8,558	1,177	63	62	1,302

[1]Includes 2,656 gizzard shad.

[2]Includes 554 gizzard shad.

[3]Includes 3,136 gizzard shad.

The prevailing littoral currents and littoral drift of beach sediment throughout the study area are north to south (U.S. Army Engineer District, Detroit, 1980). This prevailing drift is reflected in the accretion of beach sediment on the north sides of groins and other shoreline structures, including the harbor's north breakwater, which interrupt the drift (Figs. 2 to 5). An exception to the prevailing north to south drift apparently occurs immediately south of the harbor, where the accretion of beach sediment on the south side of groins and similar structures suggests that an eddy current causes the prevailing drift to move from south to north along the shoreline in areas B and C (Figs. 2 to 5).

The beach face profile on 16 June 1980 represents the condition which existed before the Corps performed its beach nourishment activities. The accretion of beach sediment in area A and the apparent erosion of beach sediment in areas B and C (Fig. 3) are consistent with the conclusion (U.S. Army Engineer District, Detroit, 1980) that the installation of the harbor contributed to erosion of the shoreline south of the harbor by interrupting the littoral drift of beach sediment.

The removal of about 19,000 cubic meters of beach sediment from area A, the deposition of that sediment in area B, and the deposition in area C of about 35,000 cubic meters of sediment from a nearby land borrow site by the Corps in October 1980 caused changes in the beach face profile that are reflected in aerial photographs taken on 3 December 1980 (Fig. 4). Among the major changes that occurred were a retreat landward of the beach face in area A and an advance lakeward of the beach face profile in areas B and C (Fig. 4) from the position occupied on 16 June 1980 (Fig. 3). These changes, caused by the nourishment activities, were relatively short-lived in area A, but were more persistent in areas B and C (Fig. 5). On 6 December 1981 (Fig. 5) the beach face in area A occupied a position lakeward of that observed on 16 June 1980 (Fig. 3) before the removal of beach sediment occurred there in October 1980. In areas B and C, the beach face on 6 December 1981 had retreated landward from the position occupied on 3 December 1980, but had not yet returned to that occupied on 16 June 1980. The minor lakeward extension of the beach face at the northern end of area B, which occurred between 3 December 1980 and 6 December 1981, is consistent with the hypothesis that an eddy current exists in areas B and C.

2. Substrate.

The results of tests to determine if there was significant variation in particle-size distribution at station 1 among all six transects (the station most likely to be affected by beach nourishment) and for stations 1 to 4 combined among all six transects indicated that there were no significant ($P \leq 0.05$) differences in distribution during any of the six sampling periods, either before or after the beach nourishment activities. These results indicate that the beach nourishment project did not alter the composition or the relative distribution of various particle sizes within the sediments in the nearshore area near Lexington Harbor.

3. Water Quality.

The water temperatures in both years were typical of the location and season and the DO concentrations never approached levels that could be considered critical to the benthic fauna. Although the SPM and turbidity values obtained were generally high and varied widely between the nearshore and offshore stations, there was little variation between the surface and bottom at any given station, probably because of the wind-induced vertical mixing which occurred immediately prior to and during nearly all sampling periods.

Turbidity values for 21 July 1980 (App. B) and the turbidity plume visible in Figure 2 collectively suggest that the harbor breakwaters may increase turbidity in the vicinity of the harbor, by causing the resuspension of beach sediment, when littoral currents exceed some miminum velocity.

4. Macrozoobenthos.

The composition of the macrozoobenthos in the study area is similar to that recorded by Teter (1960), McKim (1962), and Schuytema and Powers (1966) in samples taken from the nearshore waters of Lake Huron.

The macrozoobenthos communities were compared before, immediately after, and 1 year after beach nourishment by using Morisita's index value of community similarity calculated for each station. The index values (Table 7) indicate that the macrozoobenthos communities at station 1 in 1980 differed in 9 of 18 comparisons from the communities present at station 1 in 1981. At stations 2 to 4, however, the index values indicated that the macrozoobenthos communities in 1980 were similar or highly similar in 51 of 54 comparisons to the macrozoobenthos communities present in 1981. The dissimilarity among the benthos communities at station 1 occurred at the reference transects I and VI, as well as at transects II, III, IV, and V, which were with the area most likely to be affected by beach nourishment. Also the variability in density estimates for oligochaetes and chironomids at transect III, stations 2 and 3, is in part reflective of the highly variable substrate found here. It is concluded therefore that the beach nourishment activities were not responsible for this dissimilarity. A more likely explanation is that the unstable substrate at station 1 on all transects caused the macrozoobenthos to occur there in such low densities that the communities present were often dissimilar.

5. Fish.

Gillnet and seine catches made during the present study indicate that the fish community in the vicinity of the Lexington Harbor is typical of that in the nearshore waters of lower Lake Huron. Lists of species taken before and after beach nourishment activities were conducted differed little and the species that dominated the catch in 1980 were also the most abundant species in 1981. The major exception was the gizzard shad which was taken in very large numbers only in October 1980, immediately after beach nourishment was accomplished, and was virtually absent from the catch at other times. The sporadic appearance of large numbers of gizzard shad in the nearshore waters of the Great Lakes in the fall, (Edsall and Yocom, 1972; Caroots, 1976; Goodyear, 1978; Werner and Manny, 1979) appears typical of the species. Thus the large catch made in October 1980 is probably unrelated to the beach nourishment activities earlier in the month. The virtual absence of gizzard shad from the catches in November 1981 may reflect the tendency for the species to be more abundant in the nearshore waters in October than in November, as reported by Caroots (1976).

Although the total catch in 1980 was larger than in 1981, due mainly to the large catch of gizzard shad, there were also decreases from 1980 to 1981 in the catch of other species. However, a comparison of the catches of these other species on transect IV, which was located in the area most likely to be affected by the beach nourishment activity, with catches made on transects I and VI, the reference transects (Tables 9 and 10), revealed no adverse changes that could be attributed to the beach nourishment activities. Gillnet catches at transect IV in the nourishment area in July and October 1980 were smaller than in July and November 1981, and catches at transects I and VI in the control areas also showed similar trends. The larger seine catch at transect IV in June 1981 than in June 1980 also indicates that the beach nourishment activity did not have an effect on the distribution of fish in the study area (Table 10). The seine catch was lower at transect IV in July and November 1981 than in July and October 1980, but similar declines were evident at transects I and VI. These results indicate that the beach nourishment activity had no adverse effect on the distribution and abundance of fish near the Lexington Harbor throughout the period of study.

V. CONCLUSION

The results of this study indicate that the Corps' beach nourishment project conducted in October 1980 at the Lexington Harbor had no major adverse impact on substrate particle-size distribution, water quality, macrozoobenthos, or fish in the study area. Marked changes in the beach face profile occurred in the immediate vicinity of the harbor as a result of the nourishment activity; however, the only obvious change that persisted until the completion of this study about 14 months later was a moderate lakeward extension of the beach face in the area immediately south of the harbor.

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APPENDIX A

PARTICLE-SIZE DISTRIBUTION DATA

			FRACTION WEIGHT (G) BY U.S. STANDARD SIEVE SERIES NO.				
DATE	TRANSECT	STATION	10	35	60	120	230
6/ 9/80	I	1	7.7	29.0	264.2	663.8	14.9
		2	1.2	0.6	8.2	288.9	50.2
		3	2.7	2.6	6.2	216.0	121.1
		4	72.3	54.6	40.2	225.5	264.4
	II	1	1.6	12.5	393.6	462.9	3.5
		2	4.9	1.0	13.3	275.3	59.8
		3	0.2	2.5	36.1	408.9	194.4
		4	0.1	3.1	30.5	109.5	13.3
	III	1	1.8	3.6	357.1	98.2	0.8
		2	12.7	21.0	135.4	422.0	40.7
		3	0.1	0.7	3.4	373.5	126.8
		4	23.0	22.3	115.2	197.4	118.1
	IV	1	12.0	26.0	658.0	583.9	14.6
		2	2.1	7.9	14.7	347.2	93.5
		3	1.8	19.5	38.4	354.8	161.1
		4	11.5	83.2	499.3	363.3	17.3
	V	1	1.4	2.1	184.9	447.1	8.6
		2	1.5	28.7	430.3	915.3	54.2
		3	0.7	23.3	164.4	443.8	71.2
		4	0.8	4.7	43.2	346.1	136.2
	VI	1	0.2	1.3	5.9	108.0	3.9
		2	0.1	1.8	28.5	468.3	39.6
		3	87.5	185.9	969.5	181.0	23.2
		4	24.5	139.0	453.0	146.0	24.4
7/21/80	I	1	430.9	160.2	188.4	142.6	1.9
		2	24.6	29.3	12.4	23.2	4.6
		3	0.1	1.0	5.7	437.2	240.0
		4	2.4	58.0	111.4	59.9	81.9
	II	1	7.2	9.6	195.0	525.3	31.4
		2	0.1	1.2	30.0	490.4	80.0
		3	0.3	6.3	86.5	1112.0	146.8
		4	1.3	7.8	73.6	246.3	59.4
	III	1	1.1	32.3	838.2	69.4	3.9
		2	0.9	6.5	135.1	388.2	44.9
		3	4.5	19.2	41.6	258.6	50.2
		4	24.6	152.4	419.8	284.5	35.9
	IV	1	93.4	14.5	664.7	316.9	6.0
		2	0.3	6.5	80.1	830.5	181.0
		3	1.4	15.1	69.4	420.7	154.1
		4	49.4	44.8	72.9	23.9	9.4
	V	1	0.7	8.7	407.3	845.2	30.9
		2	1.8	37.2	183.1	783.7	58.3
		3	3.5	9.8	64.1	667.7	115.4
		4	1.0	10.8	102.4	624.4	156.3
	VI	1	21.6	56.0	417.5	553.3	4.7
		2	0.0	0.7	21.7	172.7	28.0
		3	1.5	7.3	95.4	555.8	161.6
		4	3.6	23.8	132.2	274.5	345.1

			FRACTION WEIGHT (G) BY U.S. STANDARD SIEVE SERIES NO.				
DATE	TRANSECT	STATION	10	35	60	120	230
10/14/80	I	1	63.9	16.9	198.0	286.5	12.7
		2	0.0	0.6	36.3	444.0	49.3
		3	17.0	16.3	34.0	364.8	61.7
		4	21.9	164.4	139.1	317.8	234.5
	II	1	1.5	11.3	625.1	287.7	6.6
		2	13.3	4.7	18.3	634.9	104.4
		3	0.3	24.0	136.2	459.0	95.9
		4	4.4	28.6	370.8	482.6	43.2
	III	1	4.6	12.6	225.2	503.8	12.3
		2	1.0	13.2	107.1	232.1	27.8
		3	0.8	5.8	22.1	820.5	108.7
		4	129.1	73.8	248.6	85.9	8.1
	IV	1	0.1	2.3	33.2	107.1	4.0
		2	0.0	1.0	73.6	619.8	69.1
		3	0.2	1.7	6.2	271.3	142.1
		4	16.0	28.7	22.8	181.0	148.8
	V	1	0.9	11.9	195.7	627.1	34.0
		2	0.4	7.0	49.8	598.7	78.1
		3	0.0	4.7	85.0	127.2	26.8
		4	2.0	7.0	69.0	146.3	16.4
	VI	1	0.1	0.8	27.7	176.3	11.5
		2	0.1	1.1	75.5	464.6	23.9
		3	3.9	22.0	147.2	384.1	173.5
		4	3.3	8.5	97.9	182.8	11.2
6/10/81	I	1	0.1	0.8	47.9	234.2	6.3
		2	0.0	0.2	26.7	485.5	35.2
		3	0.1	0.1	1.2	20.2	3.0
		4	2.8	8.5	47.3	119.6	28.5
	II	1	47.0	58.7	298.3	422.0	16.0
		2	3.1	2.0	12.2	290.8	57.8
		3	0.0	0.4	7.9	269.6	56.2
		4	0.0	0.1	0.5	2.6	2.1
	III	1	0.2	3.3	485.7	699.0	4.3
		2	0.0	0.1	0.8	26.8	2.4
		3	1.6	5.3	21.6	246.2	147.6
		4	0.0	0.1	0.6	122.5	72.3
	IV	1	1.9	4.1	422.7	342.9	4.9
		2	6.0	40.4	81.8	368.3	131.7
		3	0.2	5.0	18.2	198.6	181.1
		4	0.1	0.9	3.3	50.0	55.2
	V	1	2.9	11.7	328.9	451.7	37.0
		2	0.0	1.3	198.9	652.6	14.4
		3	0.1	3.5	44.5	652.3	87.3
		4	1.1	11.3	49.2	285.1	182.4
	VI	1	349.2	282.3	294.3	180.8	1.5
		2	0.1	2.1	45.8	617.2	43.3
		3	0.1	1.0	24.6	385.2	67.7
		4	0.3	11.0	247.8	230.0	66.2

			FRACTION WEIGHT (G) BY U.S. STANDARD SIEVE SERIES NO.				
DATE	TRANSECT	STATION	10	35	60	120	230
7/14/81	I	1	0.1	0.4	17.9	804.1	23.2
		2	0.1	0.6	34.0	744.1	69.0
		3	0.1	7.2	665.9	20.5	80.6
		4	0.4	2.1	16.9	435.6	133.8
	II	1	4.2	5.6	60.8	401.0	17.8
		2	0.1	2.0	48.1	705.8	63.0
		3	0.1	0.3	1.4	196.8	136.0
		4	3.7	27.5	181.8	234.2	65.6
	III	1	0.4	7.0	519.2	168.4	2.0
		2	0.9	3.5	27.6	594.2	138.1
		3	0.2	2.6	56.8	436.5	186.7
		4	7.9	4.3	24.2	626.4	83.0
	IV	1	0.3	8.2	324.6	197.7	72.7
		2	13.8	19.6	227.8	770.6	16.4
		3	12.6	19.6	129.8	489.8	81.2
		4	0.9	6.2	8.3	295.6	384.9
	V	1	0.3	3.2	100.8	226.9	95.3
		2	0.1	1.5	67.3	683.1	17.4
		3	0.1	0.6	6.2	121.4	14.4
		4	3.6	8.3	52.2	306.3	155.2
	VI	1	5.5	5.3	71.5	101.3	5.0
		2	1.0	3.4	272.0	834.7	13.9
		3	0.5	1.3	11.5	427.6	103.8
		4	3.5	7.2	26.5	82.3	74.4
10/ 8/81	I	1	1.5	3.9	90.1	409.7	10.7
		2	0.0	1.0	13.8	533.8	133.2
		3	7.0	3.0	6.4	381.6	97.7
		4	19.3	78.3	90.9	167.5	235.6
	II	1	26.5	34.5	176.1	539.0	13.9
		2	0.8	1.6	71.3	829.2	42.1
		3	0.1	0.3	1.2	182.5	187.3
		4	12.5	26.3	336.9	524.3	63.1
	III	1	7.2	11.5	499.5	458.5	13.9
		2	0.1	0.8	31.8	511.2	87.9
		3	2.4	6.7	42.3	147.0	100.2
		4	3.5	10.7	21.9	210.2	121.4
	IV	1	31.0	27.0	542.2	367.8	3.5
		2	1.1	4.3	20.9	281.6	54.0
		3	0.3	2.6	31.2	224.5	73.5
		4	0.0	0.4	3.5	264.4	386.8
	V	1	0.1	2.0	54.0	195.8	22.8
		2	0.2	3.8	132.0	1131.2	58.9
		3	0.1	4.5	46.5	680.9	76.9
		4	1.6	7.4	36.9	284.9	184.6
	VI	1	3.4	7.0	218.7	661.0	8.0
		2	0.1	1.1	130.2	808.2	27.7
		3	0.2	4.3	35.1	904.9	138.4
		4	2.2	17.5	142.0	74.9	12.2

APPENDIX B

WATER QUALITY DATA

DATE	TRANSECT	STATION	DISSOLVED OXYGEN (PPM) SURFACE	DISSOLVED OXYGEN (PPM) BOTTOM	TEMPERATURE (C) SURFACE	TEMPERATURE (C) BOTTOM	SUSPENDED PARTICULATE MATTER (MG/L) SURFACE	SUSPENDED PARTICULATE MATTER (MG/L) BOTTOM	TURBIDITY (NTU'S) SURFACE	TURBIDITY (NTU'S) BOTTOM
6/18/80	I	1	12.2	****1/	14.5	****	7.80	******	7.1	****
		2	12.5	12.8	13.0	12.5	6.50	5.70	2.3	3.1
		3	12.4	12.6	11.0	11.0	4.00	4.30	2.9	2.0
		4	12.3	12.6	11.0	11.0	3.40	2.60	1.8	1.4
	II	1	12.8	****	14.0	****	8.20	******	7.4	****
		2	12.6	12.8	12.0	12.0	4.80	4.40	2.2	2.2
		3	12.6	12.7	11.5	11.5	3.30	3.90	2.2	2.0
		4	12.3	12.4	11.2	11.0	3.30	2.90	1.7	1.4
	III	1	13.0	****	13.0	****	6.40	******	5.3	****
		2	12.7	12.7	12.0	12.0	4.00	3.20	1.9	1.4
		3	12.4	12.7	11.6	11.2	4.50	3.90	2.8	2.1
		4	12.4	12.5	11.2	11.0	2.80	2.20	1.2	1.8
	IV	1	13.2	****	13.2	****	9.90	******	5.2	****
		2	12.6	12.7	11.8	11.9	3.30	2.50	1.6	1.6
		3	12.5	12.5	11.2	11.2	2.50	2.70	1.7	1.7
		4	12.4	12.5	11.1	11.0	2.80	3.30	1.8	1.6
	V	1	12.6	****	13.5	****	11.30	******	6.7	****
		2	12.6	12.7	12.3	12.2	4.20	4.60	2.2	2.5
		3	12.4	12.4	11.8	11.9	4.00	3.80	1.8	1.9
		4	12.3	12.4	11.3	11.2	4.10	3.60	1.9	2.2
	VI	1	12.2	****	13.8	****	7.00	******	6.9	****
		2	12.6	12.6	12.1	12.1	4.40	5.60	2.8	2.8
		3	12.4	12.4	11.9	11.8	4.00	3.50	2.3	2.3
		4	12.3	12.4	11.7	11.6	2.80	3.80	2.2	2.2
7/21/80	I	1	9.9	****	18.8	****	4.80	******	1.8	****
		2	10.4	11.7	18.2	17.5	1.70	1.30	1.1	1.1
		3	10.5	10.6	15.3	15.0	1.60	4.40	1.2	1.8
		4	10.9	10.9	16.8	16.2	2.10	2.60	1.4	1.4
	II	1	9.9	****	19.2	****	66.00	******	54.5	****
		2	10.0	9.8	18.2	18.2	26.40	25.50	17.5	18.0
		3	10.5	10.4	17.4	16.9	4.40	5.20	2.1	1.9
		4	10.7	10.6	16.2	16.2	3.00	4.10	1.6	1.4
	III	1	9.7	****	18.8	****	24.80	******	20.0	****
		2	9.6	9.6	18.2	17.6	13.60	13.60	12.0	11.5
		3	10.1	9.9	16.8	16.6	8.20	15.80	5.5	8.4
		4	10.2	10.1	17.0	15.9	7.90	3.70	4.8	1.4
	IV	1	10.2	****	19.2	****	29.00	******	13.3	****
		2	9.9	9.9	18.0	17.8	8.80	8.40	6.0	4.7
		3	9.9	9.6	17.2	17.0	9.20	11.00	5.7	4.9
		4	10.1	9.8	17.2	16.8	4.40	4.70	1.9	2.2
	V	1	9.4	****	20.0	****	133.60	******	81.0	****
		2	9.9	9.9	18.2	18.1	13.20	11.50	6.8	6.3
		3	10.0	9.9	17.1	17.1	2.90	8.30	1.9	2.4
		4	10.2	10.0	16.7	16.7	3.00	2.90	1.4	1.6
	VI	1	9.4	****	21.0	****	42.50	******	19.3	****
		2	9.4	9.4	20.0	19.5	17.20	20.00	18.8	21.5
		3	9.8	9.8	19.0	18.9	16.00	8.80	5.6	5.4
		4	9.8	9.8	19.2	18.6	2.90	4.40	1.3	1.2

1/ * Indicates that no sample was taken.

DATE	TRANSECT	STATION	DISSOLVED OXYGEN (PPM) SURFACE	DISSOLVED OXYGEN (PPM) BOTTOM	TEMPERATURE (C) SURFACE	TEMPERATURE (C) BOTTOM	SUSPENDED PARTICULATE MATTER (MG/L) SURFACE	SUSPENDED PARTICULATE MATTER (MG/L) BOTTOM	TURBIDITY (NTU'S) SURFACE	TURBIDITY (NTU'S) BOTTOM
10/20/80	I	1	11.0	****	10.0	****	1.90	******	9.7	****
		2	11.0	10.9	10.0	10.0	6.50	10.20	1.8	2.8
		3	11.0	10.8	11.0	10.0	6.80	12.00	1.4	2.4
		4	10.8	10.8	11.0	11.0	6.00	13.00	1.4	2.3
	II	1	11.0	****	10.0	****	10.00	******	6.2	****
		2	11.1	11.0	10.0	10.0	11.60	26.80	3.9	4.6
		3	11.0	11.0	10.5	10.0	7.80	8.80	4.0	4.0
		4	11.0	11.1	10.5	10.0	11.00	32.60	4.1	6.0
	III	1	11.0	****	10.0	****	8.20	******	5.1	****
		2	11.0	11.0	10.2	10.2	9.00	31.00	6.5	6.5
		3	10.9	11.0	10.5	10.0	10.40	11.40	3.9	5.8
		4	10.9	11.0	10.6	10.5	5.20	8.40	3.0	3.2
	IV	1	10.9	****	10.2	****	8.70	******	6.7	****
		2	11.0	11.0	10.2	10.1	8.80	11.20	5.0	6.0
		3	10.9	11.0	10.2	10.2	14.40	12.20	5.5	5.6
		4	10.8	11.0	10.5	10.2	8.60	9.60	3.4	4.1
	V	1	10.8	****	10.5	****	10.40	******	6.6	****
		2	11.1	11.0	10.0	10.0	12.20	25.40	8.0	10.9
		3	11.0	11.0	10.0	10.0	13.00	17.00	7.1	8.4
		4	10.9	10.8	10.7	10.5	6.80	8.20	2.5	2.8
	VI	1	10.9	****	10.5	****	9.20	******	5.3	****
		2	11.0	10.9	10.5	10.5	10.00	10.40	3.6	6.2
		3	11.0	11.0	10.1	10.1	6.00	10.00	3.9	4.0
		4	10.8	10.8	10.8	10.6	18.40	7.80	2.5	3.7
6/15/81	I	1	12.3	****	13.3	****	11.40	******	3.2	****
		2	12.8	12.8	12.5	12.2	2.60	2.60	1.0	1.0
		3	12.9	12.7	11.2	11.2	2.70	3.10	0.8	0.9
		4	12.6	12.7	11.2	10.5	3.00	2.90	0.6	0.8
	II	1	12.7	****	13.8	****	6.60	******	1.7	****
		2	12.2	12.2	13.0	13.0	2.90	4.10	1.1	0.9
		3	12.0	12.2	13.0	12.9	3.10	4.40	0.8	1.1
		4	11.9	12.0	12.7	12.6	1.70	2.90	0.8	0.8
	III	1	12.2	****	14.3	****	5.00	******	1.2	****
		2	11.8	12.1	13.3	13.3	6.00	6.70	1.6	1.6
		3	11.9	12.2	13.0	12.8	4.10	6.40	1.2	1.1
		4	11.9	11.9	13.0	13.0	2.00	11.70	0.8	2.7
	IV	1	12.0	****	15.0	****	10.90	******	3.0	****
		2	11.6	11.8	13.0	13.0	3.30	4.70	1.0	1.1
		3	11.8	12.0	12.8	12.8	3.90	3.70	1.0	0.8
		4	11.8	12.1	12.8	12.8	4.30	4.10	0.8	0.9
	V	1	12.1	****	14.9	****	6.30	******	1.5	****
		2	11.7	11.8	13.2	13.3	3.70	4.10	0.8	1.2
		3	11.7	11.9	13.1	13.1	3.90	4.60	0.9	1.2
		4	11.8	12.0	12.8	12.8	3.00	4.10	0.9	1.0
	VI	1	11.3	****	16.3	****	12.90	******	3.6	****
		2	11.6	11.6	14.7	14.8	5.10	6.00	1.1	1.4
		3	11.5	11.7	14.0	14.0	1.70	4.10	1.0	1.1
		4	11.5	11.9	13.8	13.7	4.40	4.10	1.0	1.1

DATE	TRANSECT	STATION	DISSOLVED OXYGEN (PPM)		TEMPERATURE (C)		SUSPENDED PARTICULATE MATTER (MG/L)		TURBIDITY (NTU'S)	
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM
7/15/81	I	1	10.8	****	22.3	****	44.90	******	7.5	****
		2	10.9	10.2	22.0	21.3	32.00	34.70	3.1	5.5
		3	10.8	8.4	22.0	21.3	31.10	33.40	1.6	4.0
		4	11.2	9.8	22.0	21.3	30.10	35.10	1.4	4.4
	II	1	11.2	****	22.8	****	43.40	******	4.2	****
		2	11.3	10.8	21.9	21.9	30.40	34.60	1.9	2.6
		3	11.6	10.9	22.0	21.5	31.10	33.00	1.2	2.0
		4	11.4	11.3	21.9	21.2	28.70	38.70	1.1	3.7
	III	1	10.6	****	23.8	****	52.20	******	8.3	****
		2	11.2	11.8	22.2	21.5	33.90	32.40	5.7	5.3
		3	10.6	10.7	22.0	21.2	34.40	56.00	3.6	10.2
		4	11.4	11.4	21.9	21.2	32.40	54.80	1.1	4.2
	IV	1	11.0	****	23.0	****	49.60	******	5.8	****
		2	10.9	11.3	22.1	21.9	28.40	46.80	1.7	1.9
		3	11.1	11.2	22.0	21.5	27.60	50.40	1.5	1.8
		4	11.3	11.4	21.9	21.1	32.30	46.80	1.2	2.7
	V	1	11.6	****	22.8	****	63.80	******	14.0	****
		2	11.2	11.5	22.0	22.0	31.00	42.20	1.3	2.4
		3	11.2	11.4	22.0	21.9	31.30	40.40	1.4	1.9
		4	11.3	11.4	21.9	21.2	28.10	48.20	0.9	4.2
	VI	1	11.4	****	23.0	****	51.20	******	2.3	****
		2	11.4	11.6	22.2	22.0	28.30	48.00	2.4	3.1
		3	11.2	11.4	22.0	22.0	33.90	43.80	2.1	2.5
		4	11.2	11.8	21.8	21.0	31.30	30.00	1.4	2.5
10/ 8/81	I	1	10.5	****	11.4	****	129.20	******	56.5	****
		2	10.6	10.4	11.4	11.5	47.60	53.20	27.5	29.5
		3	10.2	10.2	11.5	11.5	12.00	20.00	8.6	11.7
		4	10.2	10.4	11.5	11.5	16.30	16.30	8.7	9.0
	II	1	11.0	****	11.2	****	55.70	******	31.0	****
		2	10.2	10.4	11.5	11.5	28.30	23.70	15.7	13.9
		3	10.1	10.4	11.9	11.5	19.30	43.30	14.2	21.7
		4	9.8	10.4	11.9	11.1	145.00	42.70	10.3	21.7
	III	1	10.5	****	11.0	****	39.30	******	22.5	****
		2	10.1	10.3	11.0	10.9	35.00	35.00	24.5	23.0
		3	9.9	9.8	10.9	10.9	26.30	63.70	17.5	35.0
		4	9.6	9.6	11.5	11.5	21.00	17.00	11.8	11.4
	IV	1	10.5	****	11.2	****	81.30	******	40.5	****
		2	9.7	9.8	11.2	11.2	45.00	56.00	24.0	27.5
		3	9.9	10.1	11.5	11.5	32.00	17.30	16.9	16.2
		4	9.8	10.2	12.0	11.5	16.70	28.00	10.5	17.7
	V	1	10.6	****	11.5	****	95.30	******	50.0	****
		2	10.0	10.0	11.5	11.5	42.70	37.00	25.0	17.7
		3	10.3	10.5	11.5	11.5	35.00	95.30	17.7	40.5
		4	10.0	10.3	12.0	11.5	15.00	35.00	11.4	21.5
	VI	1	10.6	****	11.5	****	95.70	******	70.5	****
		2	10.0	10.2	11.5	11.2	23.30	48.30	20.2	23.4
		3	10.0	10.4	11.5	11.5	21.30	117.30	13.9	51.0
		4	9.9	10.3	11.5	11.5	10.70	20.00	8.2	15.6

APPENDIX C

MACROZOOBENTHOS DATA

DATE	TRANSECT	STATION	TAXON	GRAB COUNTS			MEAN NO. /SQ.M
6/10/80	I	1	CHIRONOMIDAE	1	0	0	7
			GAMMARUS	1	0	0	7
		2	CHIRONOMIDAE	5	3	0	55
			OLIGOCHAETA	1	1	0	14
		3	CHIRONOMIDAE	5	14	**** 1/	196
			OLIGOCHAETA	7	4	****	114
			CORIXIDAE	2	0	****	21
			OSTRACODA	0	1	****	10
		4	OLIGOCHAETA	52	100	23	1205
			CHIRONOMIDAE	22	52	17	627
			OSTRACODA	0	1	3	28
			GAMMARUS	1	1	0	14
			CORIXIDAE	1	0	0	7
			ACARINA	1	0	0	7
			RHABDOCOELA	0	1	0	7
	II	1	CHIRONOMIDAE	2	1	0	21
			CHEUMATOPSYCHE	1	0	0	7
			OSTRACODA	0	1	0	7
		2	CHIRONOMIDAE	3	0	5	55
			ACARINA	0	0	2	14
			CORIXIDAE	0	0	2	14
			OLIGOCHAETA	0	0	2	14
			LEPTOCERIDAE	0	0	1	7
		3	OLIGOCHAETA	24	28	75	875
			CHIRONOMIDAE	24	9	59	634
			GAMMARUS	1	0	0	7
			NEMATODA	0	1	0	7
			CORIXIDAE	0	1	0	7
			OSTRACODA	1	0	0	7
		4	CHIRONOMIDAE	19	20	8	324
			OLIGOCHAETA	3	13	1	117
			HYALELLA AZTECA	0	2	0	14
			GAMMARUS	1	0	1	14
			CORIXIDAE	1	0	0	7
			PISIDIUM	1	0	0	7
	III	1	CHIRONOMIDAE	1	1	0	14
			CORIXIDAE	0	1	1	14
			OLIGOCHAETA	0	1	0	7
		2	CHIRONOMIDAE	9	16	19	303
			OLIGOCHAETA	10	5	2	117
			NEMATODA	1	3	0	28
			CORIXIDAE	1	1	1	21
			CAENIS	0	1	0	7
			HYDRA	0	1	0	7
			OSTRACODA	1	0	0	7
		3	OLIGOCHAETA	147	21	112	1928
			CHIRONOMIDAE	41	25	23	613
			OSTRACODA	1	0	4	34
			SETODES	4	0	0	28
			CAENIS	1	0	2	21
			POLYCENTROPUS	0	1	1	14
			NEMATODA	2	0	0	14
			HYDRA	1	0	0	7
			CORIXIDAE	0	1	0	7
			GAMMARUS	1	0	0	7
			TRICLADIDA	1	0	0	7
		4	CHIRONOMIDAE	8	28	24	413
			OLIGOCHAETA	31	10	7	331
			GAMMARUS	0	0	1	7

1/ * Indicates that no sample was taken.

TRANSECT	STATION	TAXON	GRAB COUNTS			MEAN NO. /SQ.M
IV	1	CHIRONOMIDAE	2	6	5	90
		OLIGOCHAETA	2	0	0	14
		CORIXIDAE	1	0	0	7
	2	CHIRONOMIDAE	32	11	15	399
		OLIGOCHAETA	13	3	10	179
		CORIXIDAE	1	0	1	14
		OSTRACODA	2	0	0	14
		GAMMARUS	1	0	0	7
	3	CHIRONOMIDAE	100	171	88	2472
		OLIGOCHAETA	16	66	113	1343
		OSTRACODA	19	9	3	213
		CAENIS	1	0	1	14
		NEMATODA	0	1	1	14
		PISIDIUM	1	0	1	14
		ACARINA	1	0	0	7
		AMNICOLA	1	0	0	7
		HYALELLA AZTECA	0	1	0	7
		LEPTOCERIDAE	0	1	0	7
		RHABDOCOELA	0	0	1	7
		VALVATA SINCER	1	0	0	7
	4	CHIRONOMIDAE	25	20	5	344
		OLIGOCHAETA	6	11	2	131
		MYSTACIDES	0	3	1	28
		HYDRA	0	1	0	7
		CAENIS	0	1	0	7
		OECETIS	0	1	0	7
		CORIXIDAE	0	0	1	7
V	1	CORIXIDAE	1	0	2	21
	2	CHIRONOMIDAE	2	13	4	131
		OLIGOCHAETA	0	2	0	14
	3	CHIRONOMIDAE	12	7	8	186
		OLIGOCHAETA	5	3	12	138
		GAMMARUS	2	2	5	62
		CORIXIDAE	0	1	1	14
		ACARINA	0	1	0	7
		CAENIS	0	1	0	7
	4	OLIGOCHAETA	101	28	35	1129
		CHIRONOMIDAE	4	8	17	200
		GAMMARUS	0	2	1	21
		NEMATODA	0	1	1	14
		PISIDIUM	0	1	0	7
VI	1	CORIXIDAE	5	0	2	48
		CHIRONOMIDAE	1	2	3	41
		OLIGOCHAETA	0	2	3	34
		CAENIS	2	1	0	21
		HYDRA	2	0	0	14
		GYRAULUS	0	1	0	7
	2	CHIRONOMIDAE	8	3	10	145
	3	OLIGOCHAETA	1	31	0	220
		CHIRONOMIDAE	6	8	5	131
		GAMMARUS	1	1	0	14
		CORIXIDAE	1	0	1	14
		PISIDIUM	0	2	0	14
		CAENIS	0	0	1	7
	4	CHIRONOMIDAE	5	243	21	1853
		OLIGOCHAETA	1	113	1	792
		PISIDIUM	0	3	1	28
		CORIXIDAE	1	1	0	14
		GYRAULUS	1	0	0	7
		HEXAGENIA	0	1	0	7
		AMNICOLA	0	1	0	7
		OSTRACODA	0	1	0	7
		CAENIS	0	1	0	7

DATE	TRANSECT	STATION	TAXON	GRAB COUNTS			MEAN NO. /SQ.M
7/21/80	I	1	CHIRONOMIDAE	8	2	0	69
			OLIGOCHAETA	1	0	0	7
		2	CHIRONOMIDAE	16	81	31	881
			OLIGOCHAETA	3	27	44	510
			OSTRACODA	0	3	1	28
			HIRUDINEA	0	0	1	7
			NEMATODA	0	1	0	7
			CORIXIDAE	0	1	0	7
			GAMMARUS	1	0	0	7
			PISIDIUM	0	1	0	7
			RHABDOCOELA	0	1	0	7
		3	OLIGOCHAETA	100	204	71	2582
			CHIRONOMIDAE	27	24	25	523
			CORIXIDAE	1	2	1	28
			GAMMARUS	1	0	1	14
			NEMATODA	0	1	0	7
			HIRUDINEA	0	1	0	7
			OSTRACODA	0	0	1	7
			RHABDOCOELA	0	0	1	7
		4	OLIGOCHAETA	79	34	23	937
			CHIRONOMIDAE	26	1	14	282
			PISIDIUM	1	0	7	55
			RHABDOCOELA	5	0	2	48
			CORIXIDAE	1	1	1	21
			GAMMARUS	2	0	0	14
			OSTRACODA	1	0	1	14
			ACARINA	1	0	0	7
			HYALELLA AZTECA	1	0	0	7
	II	1	CHIRONOMIDAE	3	3	3	62
			OLIGOCHAETA	0	0	7	48
			ACARINA	1	0	0	7
		2	CHIRONOMIDAE	12	8	38	399
			OLIGOCHAETA	1	2	8	76
			HIRUDINEA	2	0	0	14
			CORIXIDAE	0	0	1	7
			GAMMARUS	1	0	0	7
			OSTRACODA	0	0	1	7
		3	OLIGOCHAETA	11	12	17	275
			CHIRONOMIDAE	15	5	7	186
			GAMMARUS	0	2	1	21
			RHABDOCOELA	1	0	2	21
			AMNICOLA	1	0	0	7
			OSTRACODA	0	0	1	7
			PISIDIUM	0	0	1	7
			HYALELLA AZTECA	0	1	0	7
		4	CHIRONOMIDAE	24	12	14	344
			OLIGOCHAETA	20	11	17	331
			CORIXIDAE	4	3	6	90
			RHABDOCOELA	3	1	4	55
			GAMMARUS	2	0	4	41
			PISIDIUM	0	1	2	21
			NEMATODA	1	1	0	14

DATE	TRANSECT	STATION	TAXON	GRAB COUNTS			MEAN NO. /SQ.M
7/21/80	III	1	CHIRONOMIDAE	11	2	3	110
			OLIGOCHAETA	11	2	0	90
			RHABDOCOELA	0	0	2	14
			OSTRACODA	1	0	0	7
			CORIXIDAE	0	0	1	7
		2	OLIGOCHAETA	24	1	47	496
			CHIRONOMIDAE	8	4	11	158
			ACARINA	0	1	1	14
			RHABDOCOELA	0	0	1	7
		3	OLIGOCHAETA	106	195	146	3078
			CHIRONOMIDAE	141	98	150	2679
			OSTRACODA	3	0	13	110
			HIRUDINEA	0	13	0	90
			PISIDIUM	1	0	5	41
			RHABDOCOELA	2	2	0	28
			CORIXIDAE	1	0	0	7
			HYDRA	0	0	1	7
			NEMATODA	0	0	1	7
			OECETIS	0	1	0	7
		4	CHIRONOMIDAE	25	26	11	427
			OLIGOCHAETA	7	19	22	331
			CORIXIDAE	3	0	0	21
			GAMMARUS	1	0	1	14
			NEMATODA	0	0	1	7
			RHABDOCOELA	0	1	0	7
	IV	1	CHIRONOMIDAE	3	3	9	103
			ACARINA	0	1	0	7
			HIRUDINEA	0	1	0	7
		2	OLIGOCHAETA	17	16	37	482
			CHIRONOMIDAE	11	26	28	448
			RHABDOCOELA	0	4	0	28
			GAMMARUS	1	2	0	21
			PISIDIUM	1	0	0	7
			AMNICOLA	0	0	1	7
		3	CHIRONOMIDAE	16	8	2	179
			OLIGOCHAETA	5	9	2	110
			RHABDOCOELA	2	0	0	14
			CORIXIDAE	0	1	0	7
		4	OLIGOCHAETA	60	57	36	1054
			CHIRONOMIDAE	22	32	83	943
			CORIXIDAE	5	2	2	62
			OSTRACODA	1	0	1	14
			PISIDIUM	1	0	1	14
			GAMMARUS	1	0	0	7
			RHABDOCOELA	0	0	1	7
			SETODES	0	0	1	7

DATE	TRANSECT	STATION	TAXON	GRAB COUNTS			MEAN NO. /SQ.M
7/21/80	V	1	CORIXIDAE	0	1	3	28
			CHIRONOMIDAE	0	0	2	14
		2	CHIRONOMIDAE	5	7	4	110
			OLIGOCHAETA	1	1	6	55
			GAMMARUS	2	0	1	21
			RHABDOCOELA	1	0	0	7
		3	OLIGOCHAETA	23	14	31	468
			CHIRONOMIDAE	9	8	8	172
			GAMMARUS	1	1	1	21
			CORIXIDAE	1	0	1	14
			RHABDOCOELA	1	1	0	14
			NEMATODA	0	1	0	7
		4	OLIGOCHAETA	58	50	51	1095
			CHIRONOMIDAE	20	14	16	344
			RHABDOCOELA	2	6	2	69
			GAMMARUS	5	3	0	55
			CORIXIDAE	0	0	3	21
			OSTRACODA	1	0	0	7
	VI	1	CHIRONOMIDAE	15	5	10	207
			OLIGOCHAETA	0	1	1	14
			CORIXIDAE	0	1	0	7
			SETODES	0	1	0	7
		2	OLIGOCHAETA	9	15	3	186
			CHIRONOMIDAE	6	4	0	69
			HIRUDINEA	1	0	0	7
			GAMMARUS	0	1	0	7
			PISIDIUM	1	0	0	7
		3	CHIRONOMIDAE	8	12	6	179
			OLIGOCHAETA	10	2	13	172
			GAMMARUS	1	1	1	21
			SETODES	0	2	1	21
			RHABDOCOELA	0	1	0	7
			CORIXIDAE	1	0	0	7
		4	OLIGOCHAETA	61	76	46	1260
			CHIRONOMIDAE	16	13	14	296
			RHABDOCOELA	4	4	2	69
			GAMMARUS	1	2	2	34
			PISIDIUM	3	0	1	28
			NEMATODA	1	2	0	21
			OSTRACODA	1	1	0	14

DATE	TRANSECT	STATION	TAXON	GRAB COUNTS			MEAN NO. /SQ.M
10/14/80	I	1	OLIGOCHAETA	1	0	0	7
		2	OLIGOCHAETA	4	2	16	152
			CHIRONOMIDAE	3	9	4	110
			GYRAULUS	1	0	0	7
			LEPTOCERIDAE	1	0	0	7
			ACARINA	1	0	0	7
			PHYSA	1	0	0	7
		3	OLIGOCHAETA	1	0	9	69
			GAMMARUS	1	0	1	14
			CHIRONOMIDAE	1	0	1	14
			AMNICOLA	0	0	1	7
			ACARINA	0	0	1	7
			PHYSA	0	0	1	7
			RHABDOCOELA	0	0	1	7
		4	OLIGOCHAETA	111	204	109	2920
			CHIRONOMIDAE	28	24	19	489
			OSTRACODA	2	4	5	76
			PISIDIUM	5	3	2	69
			RHABDOCOELA	1	3	5	62
			HEXAGENIA	1	3	1	34
			AMNICOLA	0	1	0	7
			CAENIS	1	0	0	7
			LEPTOCERIDAE	1	0	0	7
			NEMATODA	0	0	1	7
	II	1	HYALELLA AZTECA	1	0	0	7
			OLIGOCHAETA	1	0	0	7
		2	CHIRONOMIDAE	6	11	4	145
			OLIGOCHAETA	1	8	1	69
			HYALELLA AZTECA	0	1	0	7
			GAMMARUS	0	1	0	7
		3	OLIGOCHAETA	68	27	24	820
			CHIRONOMIDAE	5	8	1	96
			HYALELLA AZTECA	1	0	0	7
			ARGULUS	0	0	1	7
		4	OLIGOCHAETA	17	14	13	303
			CHIRONOMIDAE	0	2	5	48
			PISIDIUM	2	1	0	21
			HYALELLA AZTECA	1	1	0	14
			GAMMARUS	1	0	0	7

DATE	TRANSECT	STATION	TAXON	GRAB COUNTS			MEAN NO. /SQ.M
10/14/80	III	1	OLIGOCHAETA	0	11	11	152
			CHIRONOMIDAE	1	2	0	21
			ANCYLIDAE	0	0	1	7
		2	OLIGOCHAETA	433	468	571	10137
			CHIRONOMIDAE	13	38	30	558
			NEMATODA	1	0	1	14
			OSTRACODA	0	2	0	14
			POLYCENTROPUS	2	0	0	14
			AMNICOLA	1	0	0	7
			PISIDIUM	1	0	0	7
			HEXAGENIA	0	0	1	7
			RHABDOCOELA	0	1	0	7
		3	OLIGOCHAETA	21	63	29	778
			CHIRONOMIDAE	10	14	5	200
			RHABDOCOELA	1	2	0	21
			GAMMARUS	1	1	0	14
		4	OLIGOCHAETA	20	19	2	282
			PISIDIUM	6	0	0	41
			CHIRONOMIDAE	3	2	0	34
			HYALELLA AZTECA	0	1	1	14
			NEMATODA	1	0	0	7
	IV	1	CHIRONOMIDAE	1	2	0	21
			OLIGOCHAETA	2	0	0	14
		2	OLIGOCHAETA	12	2	15	200
			CHIRONOMIDAE	4	2	6	83
			GAMMARUS	1	1	0	14
			HYALELLA AZTECA	0	1	0	7
			PISIDIUM	1	0	0	7
			POLYCENTROPUS	1	0	0	7
			TRICLADIDA	0	0	1	7
		3	OLIGOCHAETA	27	49	68	992
			CHIRONOMIDAE	13	6	19	262
			GAMMARUS	1	1	2	28
			RHABDOCOELA	1	0	2	21
			HYALELLA AZTECA	0	0	1	7
			PISIDIUM	1	0	0	7
			NEMATODA	0	0	1	7
		4	OLIGOCHAETA	0	5	22	186
			CHIRONOMIDAE	0	1	10	76
			POLYCENTROPUS	0	2	0	14

DATE	TRANSECT	STATION	TAXON	GRAB COUNTS			MEAN NO. /SQ.M
10/14/80	V	1	OLIGOCHAETA	2	0	2	28
			EMPIDIDAE	1	0	0	7
			CHIRONOMIDAE	1	0	0	7
		2	CHIRONOMIDAE	2	4	2	55
			GAMMARUS	2	0	2	28
			OLIGOCHAETA	0	2	1	21
		3	OLIGOCHAETA	12	31	32	517
			CHIRONOMIDAE	4	16	11	213
			PISIDIUM	0	2	7	62
			HEXAGENIA	0	0	2	14
			HYALELLA AZTECA	0	1	1	14
			LEPTOCERIDAE	0	0	1	7
		4	OLIGOCHAETA	33	41	42	799
			CHIRONOMIDAE	7	5	10	152
			PISIDIUM	1	0	1	14
			GAMMARUS	1	0	0	7
			TRIAENODES	1	0	0	7
	VI	1	OLIGOCHAETA	0	0	1	7
		2	OLIGOCHAETA	2	2	1	34
			CHIRONOMIDAE	0	1	0	7
			HYALELLA AZTECA	0	0	1	7
			CAENIS	0	1	0	7
		3	OLIGOCHAETA	11	54	29	647
			CHIRONOMIDAE	4	8	5	117
			RHABDOCOELA	2	1	2	34
			HYALELLA AZTECA	1	0	2	21
			GAMMARUS	1	0	1	14
			PISIDIUM	1	0	0	7
			GYRAULUS	0	0	1	7
		4	OLIGOCHAETA	49	15	42	730
			CHIRONOMIDAE	12	4	2	124
			HYALELLA AZTECA	6	3	1	69
			PISIDIUM	3	0	0	21
			LEPTOCERIDAE	1	0	0	7
			HEXAGENIA	1	0	0	7
			CAENIS	1	0	0	7

DATE	TRANSECT	STATION	TAXON	GRAB COUNTS			MEAN NO. /SQ. M
6/ 8/81	I	1	CHIRONOMIDAE	0	2	1	21
			HYDRA	1	2	0	21
			CAENIS	0	2	0	14
		2	CHIRONOMIDAE	3	1	2	41
			OLIGOCHAETA	1	0	0	7
			OSTRACODA	1	0	0	7
		3	CHIRONOMIDAE	44	1	4	337
			OSTRACODA	6	0	0	41
			OLIGOCHAETA	4	0	1	34
			OECETIS	2	1	0	21
			PONTOPOREIA HOYI	1	2	0	21
			CORIXIDAE	0	0	1	7
			HYALELLA AZTECA	1	0	0	7
			PISIDIUM	1	0	0	7
			ACARINA	0	1	0	7
		4	OLIGOCHAETA	273	235	351	5916
			CHIRONOMIDAE	57	222	75	2438
			OSTRACODA	17	101	26	992
			PISIDIUM	3	6	8	117
			PONTOPOREIA HOYI	10	2	4	110
			RHABDOCOELA	0	3	0	21
			NEMATODA	1	0	1	14
			OECETIS	1	0	0	7
			ACARINA	1	0	0	7
	II	1	CAENIS	12	6	9	186
			CHIRONOMIDAE	5	0	2	48
			HYDRA	2	0	1	21
		2	CHIRONOMIDAE	10	13	7	207
			CAENIS	0	1	2	21
			HYALELLA AZTECA	0	1	0	7
			HYDRA	0	0	1	7
		3	CHIRONOMIDAE	10	12	6	193
			CAENIS	3	0	0	21
			CORIXIDAE	0	0	2	14
			RHABDOCOELA	0	0	1	7
		4	CHIRONOMIDAE	7	5	4	110
			OLIGOCHAETA	7	3	5	103
			PONTOPOREIA HOYI	0	0	4	23
			CORIXIDAE	1	0	0	7

DATE	TRANSECT	STATION	TAXON	GRAB COUNTS			MEAN NO. /SQ. M
6/ 8/81	III	1	CHIRONOMIDAE	1	1	6	55
			OLIGOCHAETA	0	1	2	21
			HYDRA	1	0	0	7
			GASTROPODA	1	0	0	7
		2	CHIRONOMIDAE	63	12	85	1135
			OLIGOCHAETA	16	1	21	262
			CAENIS	5	0	1	41
			RHABDOCOELA	1	0	5	41
			OECETIS	0	1	1	14
			ACARINA	1	1	0	14
			NEMATODA	1	0	1	14
			OSTRACODA	0	0	1	7
			GAMMARUS	0	0	1	7
		3	OLIGOCHAETA	136	122	238	3416
			CHIRONOMIDAE	41	74	106	1522
			OSTRACODA	6	8	10	165
			CAENIS	6	2	4	83
			NEMATODA	3	5	2	69
			RHABDOCOELA	0	2	6	55
			PONTOPOREIA HOYI	1	1	0	14
			ACARINA	0	0	2	14
			HYALELLA AZTECA	0	0	1	7
			CERATOPOGONIDA	0	1	0	7
		4	CHIRONOMIDAE	13	30	12	379
			OLIGOCHAETA	17	16	11	303
			CAENIS	2	1	2	34
			RHABDOCOELA	2	1	2	34
			PONTOPOREIA HOYI	0	0	3	21
			NEMATODA	1	0	0	7
			ACARINA	0	0	1	7
			CORIXIDAE	0	1	0	7
			HYALELLA AZTECA	0	0	1	7
	IV	1	CHIRONOMIDAE	6	6	5	131
			CAENIS	0	1	2	21
			HYDRA	1	0	1	14
			HYDROPTILA	1	0	0	7
			NEMATODA	0	1	0	7
			OLIGOCHAETA	0	1	0	7
			RHABDOCOELA	1	0	0	7
		2	CHIRONOMIDAE	1	9	14	165
			OLIGOCHAETA	1	2	6	62
			CAENIS	1	0	3	28
			PONTOPOREIA HOYI	2	1	0	21
			ACARINA	1	0	0	7
			RHABDOCOELA	0	1	0	7
		3	OLIGOCHAETA	3	8	65	523
			CHIRONOMIDAE	11	10	28	33[illegible]
			ACARINA	1	2	0	2[illegible]
			NEMATODA	0	1	1	14
			RHABDOCOELA	0	1	0	7
		4	CHIRONOMIDAE	6	14	57	530
			OLIGOCHAETA	15	7	11	227
			OSTRACODA	1	1	5	48
			RHABDOCOELA	0	2	3	34
			ACARINA	0	1	2	21
			CAENIS	1	1	1	21
			PISIDIUM	0	1	1	14
			PONTOPOREIA HOYI	1	1	0	14
			HYDRA	1	1	0	14

DATE	TRANSECT	STATION	TAXON	GRAB COUNTS			MEAN NO. /SQ.M
6/ 8/81	V	1	CHIRONOMIDAE	18	0	3	145
			CAENIS	1	2	2	34
			ACARINA	2	1	0	21
			HYDRA	2	0	0	14
			NEMATODA	2	0	0	14
			OLIGOCHAETA	2	0	0	14
			OSTRACODA	1	0	0	7
			RHABDOCOELA	1	0	0	7
		2	CHIRONOMIDAE	3	1	2	41
			CAENIS	1	1	0	14
			OLIGOCHAETA	1	0	1	14
		3	CHIRONOMIDAE	0	2	11	90
			CAENIS	0	1	4	34
			HYDRA	0	0	2	14
			OLIGOCHAETA	0	1	1	14
			RHABDOCOELA	0	0	2	14
			PONTOPOREIA HOYI	0	1	0	7
		4	OLIGOCHAETA	30	14	34	537
			CHIRONOMIDAE	22	8	22	358
			PONTOPOREIA HOYI	16	8	9	227
			NEMATODA	0	1	2	21
			RHABDOCOELA	1	0	2	21
			CAENIS	0	2	0	14
			OSTRACODA	0	0	1	7
			ACARINA	0	0	1	7
			HYALELLA AZTECA	0	0	1	7
	VI	1	CAENIS	1	14	17	220
			CHIRONOMIDAE	7	9	10	179
			HYDRA	0	6	1	48
			ACARINA	2	1	1	28
			CHEUMATOPSYCHE	0	0	1	7
			NEMATODA	0	0	1	7
			OSTRACODA	0	1	0	7
			PONTOPOREIA HOYI	1	0	0	7
		2	CHIRONOMIDAE	2	3	2	48
			CAENIS	2	0	0	14
			CORIXIDAE	1	0	0	7
			PONTOPOREIA HOYI	0	1	0	7
		3	OLIGOCHAETA	1	2	25	193
			CHIRONOMIDAE	4	4	9	117
			PONTOPOREIA HOYI	0	0	4	28
			CAENIS	0	0	3	21
			NEMATODA	0	0	1	7
			ACARINA	1	0	0	7
			HYDRA	0	0	1	7
		4	CHIRONOMIDAE	21	15	68	854
			OLIGOCHAETA	11	22	18	351
			HYDRA	3	14	0	117
			CAENIS	6	5	2	90
			OECETIS	5	0	1	41
			OSTRACODA	3	2	0	34
			PISIDIUM	0	0	4	28
			PONTOPOREIA HOYI	1	1	0	14
			RHABDOCOELA	1	1	0	14
			HEXAGENIA	0	0	1	7
			HYALELLA AZTECA	1	0	0	7
			ACARINA	1	0	0	7

DATE	TRANSECT	STATION	TAXON	GRAB COUNTS			MEAN NO. /SQ.M
7/14/81	I	1	CHIRONOMIDAE	4	4	5	90
			OLIGOCHAETA	0	3	2	34
			ACARINA	0	2	2	28
			HYDRA	1	1	1	21
			OSTRACODA	0	0	1	7
			PONTOPOREIA HOYI	0	1	0	7
		2	OLIGOCHAETA	3	1	15	131
			CHIRONOMIDAE	2	1	3	41
			NEMATODA	0	0	3	21
			PONTOPOREIA HOYI	3	0	0	21
			ACARINA	1	0	0	7
			CORIXIDAE	0	0	1	7
			HYDRA	0	0	1	7
		3	OLIGOCHAETA	51	29	7	599
			CHIRONOMIDAE	6	7	4	117
			PONTOPOREIA HOYI	5	5	3	90
			CORIXIDAE	0	2	0	14
			NEMATODA	1	1	0	14
			RHABDOCOELA	0	2	0	14
			ACARINA	0	1	0	7
			OSTRACODA	1	0	0	7
		4	OLIGOCHAETA	16	40	30	592
			CHIRONOMIDAE	2	9	8	131
			PONTOPOREIA HOYI	3	4	3	69
			ACARINA	0	0	4	28
			RHABDOCOELA	1	1	1	21
			CORIXIDAE	0	0	2	14
			OSTRACODA	0	0	1	7
	II	1	CHIRONOMIDAE	2	3	4	62
			ACARINA	0	0	1	7
			CORIXIDAE	0	1	0	7
			HYDRA	0	1	0	7
			OLIGOCHAETA	0	1	0	7
		2	CHIRONOMIDAE	11	17	11	269
			OLIGOCHAETA	5	0	2	48
		3	OLIGOCHAETA	32	12	35	544
			CHIRONOMIDAE	13	10	6	200
			PONTOPOREIA HOYI	1	1	0	14
			CORIXIDAE	0	0	1	7
		4	OLIGOCHAETA	6	61	136	1398
			CHIRONOMIDAE	2	8	43	365
			OSTRACODA	0	0	7	48
			PISIDIUM	1	0	4	34
			ACARINA	1	0	3	28
			RHABDOCOELA	1	1	1	21
			CORIXIDAE	0	0	2	14
			PONTOPOREIA HOYI	0	2	0	14
			NEMATODA	0	0	2	14
			PHYSA	0	0	1	7

DATE	TRANSECT	STATION	TAXON	GRAB COUNTS			MEAN NO. /SQ.M
7/14/81	III	1	OLIGOCHAETA	3	12	11	179
			CHIRONOMIDAE	12	8	3	158
			ACARINA	1	1	1	21
			NEMATODA	1	0	1	14
			PONTOPOREIA HOYI	1	1	0	14
		2	OLIGOCHAETA	128	86	15	1577
			CHIRONOMIDAE	26	22	2	344
			NEMATODA	2	1	1	28
			RHABDOCOELA	3	1	0	28
		3	OLIGOCHAETA	1210	2201	1438	33393
			CHIRONOMIDAE	50	44	59	1054
			NEMATODA	27	20	12	406
			OSTRACODA	15	18	11	303
			ACARINA	16	13	8	255
			RHABDOCOELA	2	1	2	34
			CAENIS	1	1	0	14
			CORIXIDAE	1	1	0	14
			CERACLEA	0	0	1	7
			ELMIDAE	1	0	0	7
		4	OLIGOCHAETA	50	97	121	1846
			CHIRONOMIDAE	9	12	23	303
			RHABDOCOELA	3	0	5	55
			PONTOPOREIA HOYI	2	1	4	48
			CORIXIDAE	5	0	0	34
			ACARINA	2	1	1	28
			HIRUDINEA	0	0	1	7
	IV	1	OLIGOCHAETA	15	5	25	310
			NEMATODA	8	0	27	241
			CHIRONOMIDAE	14	0	6	138
			GAMMARUS	5	0	0	34
			CAENIS	3	0	0	21
			ACARINA	1	0	1	14
			OECETIS	1	0	0	7
			CHEUMATOPSYCHE	1	0	0	7
			OSTRACODA	0	0	1	7
			PHYSA	1	0	0	7
			PISIDIUM	0	0	1	7
			RHABDOCOELA	0	1	0	7
		2	CHIRONOMIDAE	2	6	5	90
			OLIGOCHAETA	7	4	2	90
			HYALELLA AZTECA	0	1	0	7
			ACARINA	1	0	0	7
			RHABDOCOELA	1	0	0	7
		3	OLIGOCHAETA	105	9	7	833
			CHIRONOMIDAE	27	11	3	282
			CORIXIDAE	5	0	2	48
			ACARINA	5	0	0	34
			PISIDIUM	4	0	1	34
			RHABDOCOELA	0	4	1	34
			OSTRACODA	2	1	1	28
			NEMATODA	1	1	0	14
			PONTOPOREIA HOYI	0	1	0	7
			HYDROPTILA	1	0	0	7
		4	OLIGOCHAETA	158	444	133	5062
			CHIRONOMIDAE	60	158	13	1591
			OSTRACODA	4	10	9	158
			ACARINA	2	8	0	69
			CORIXIDAE	4	4	0	55
			NEMATODA	3	2	3	55
			RHABDOCOELA	5	1	0	41
			PISIDIUM	0	3	0	21
			PONTOPOREIA HOYI	0	0	1	7

DATE	TRANSECT	STATION	TAXON	GRAB COUNTS			MEAN NO. /SQ.M
7/14/81	V	1	CHIRONOMIDAE	20	12	8	275
			OLIGOCHAETA	4	10	6	139
			NEMATODA	6	6	1	90
			CORIXIDAE	3	2	1	41
			CAENIS	2	3	0	34
			ACARINA	1	0	2	21
			OSTRACODA	0	1	2	21
			EMPIDIDAE	0	1	0	7
			RHABDOCOELA	0	1	0	7
		2	CHIRONOMIDAE	5	4	4	90
			PONTOPOREIA HOYI	0	1	1	14
			ACARINA	0	0	1	7
		3	CHIRONOMIDAE	11	13	5	200
			OLIGOCHAETA	5	5	7	117
			CORIXIDAE	1	1	0	14
			ACARINA	0	1	1	14
		4	OLIGOCHAETA	50	100	116	1830
			CHIRONOMIDAE	19	22	14	393
			PONTOPOREIA HOYI	4	2	1	48
			RHABDOCOELA	2	1	3	41
			CORIXIDAE	0	0	1	7
			ACARINA	1	0	0	7
	VI	1	OLIGOCHAETA	0	15	2	117
			CHIRONOMIDAE	3	7	6	110
			GAMMARUS	1	0	0	7
			NEMATODA	0	0	1	7
			ACARINA	0	1	0	7
			RHABDOCOELA	0	1	0	7
		2	CHIRONOMIDAE	5	7	4	110
			OLIGOCHAETA	6	8	2	110
			CORIXIDAE	1	0	0	7
			PONTOPOREIA HOYI	1	0	0	7
		3	OLIGOCHAETA	4	22	31	393
			CHIRONOMIDAE	7	28	15	365
			PONTOPOREIA HOYI	1	1	0	14
			NEMATODA	0	0	1	7
			ACARINA	0	0	1	7
			PISIDIUM	0	0	1	7
			CORIXIDAE	0	0	1	7
			RHABDOCOELA	0	1	0	7
		4	OLIGOCHAETA	108	202	52	2493
			CHIRONOMIDAE	17	39	33	613
			SPHAERIIDAE	6	37	6	337
			OSTRACODA	3	9	4	110
			RHABDOCOELA	1	1	1	21
			CORIXIDAE	1	1	1	21
			ACARINA	1	1	0	14
			CAENIS	0	0	1	7
			HYDROPTILA	0	1	0	7
			MYSTACIDES	0	1	0	7
			OECETIS	0	1	0	7
			TRICHOPTERA	0	1	0	7

DATE	TRANSECT	STATION	TAXON	GRAB COUNTS			MEAN NO. /SQ.M
10/ 5/81	I	1	CHIRONOMIDAE	0	0	2	14
			PISIDIUM	0	1	0	7
			PONTOPOREIA HOYI	0	1	0	7
		2	OLIGOCHAETA	1	3	2	41
			CHIRONOMIDAE	4	0	1	34
			HYALELLA AZTECA	0	1	0	7
			ACARINA	0	0	1	7
			PISIDIUM	1	0	0	7
		3	OLIGOCHAETA	5	5	11	145
			CHIRONOMIDAE	2	1	8	76
			PONTOPOREIA HOYI	2	0	0	14
			CAENIS	0	0	1	7
			PISIDIUM	0	1	0	7
			AMNICOLA	0	1	0	7
		4	OLIGOCHAETA	547	268	1824	18174
			CHIRONOMIDAE	97	34	60	1315
			OSTRACODA	37	8	32	530
			RHABDOCOELA	4	4	12	138
			PISIDIUM	6	2	1	62
			ACARINA	2	1	2	34
			CAENIS	1	1	1	21
			PONTOPOREIA HOYI	2	0	0	14
			AMNICOLA	1	0	1	14
			NEMATODA	0	0	1	7
			HYALELLA AZTECA	1	0	0	7
	II	1	OLIGOCHAETA	0	1	1	14
			CHEUMATOPSYCHE	0	1	0	7
		2	CHIRONOMIDAE	10	8	15	227
			PONTOPOREIA HOYI	0	0	2	14
			HYDRA	0	0	1	7
			OLIGOCHAETA	0	0	1	7
			CAENIS	0	0	1	7
		3	CHIRONOMIDAE	14	15	11	275
			OLIGOCHAETA	5	6	3	96
			PONTOPOREIA HOYI	1	1	1	21
			ACARINA	0	0	1	7
			NEMATODA	0	0	1	7
		4	OLIGOCHAETA	26	32	94	1047
			CHIRONOMIDAE	15	2	16	227
			CAENIS	2	1	0	21
			NEMATODA	0	0	2	14
			AMNICOLA	2	0	0	14
			OECETIS	0	0	1	7
			OSTRACODA	0	0	1	7

DATE	TRANSECT	STATION	TAXON	GRAB COUNTS			MEAN NO. /SQ.M
10/ 5/81	III	1	OLIGOCHAETA	2	0	2	28
			MANAYUNKIA SPECIOSA 1	0	0	7	7
			CHIRONOMIDAE	1	0	0	7
		2	OLIGOCHAETA	20[illegible]	[illegible]	10[illegible]	27[illegible]
			CHIRONOMIDAE	2[illegible]	5[illegible]	[illegible]	[illegible]
			NEMATODA	0	[illegible]	[illegible]	[illegible]
			HYDRA	2	[illegible]	[illegible]	[illegible]
		3	OLIGOCHAETA	115	471	935	10[illegible]
			CHIRONOMIDAE	15	14	49	5[illegible]
			OSTRACODA	0	1	21	155
			NEMATODA	0	2	7	62
			ACARINA	0	0	6	41
			HYDRA	0	0	2	14
			OECETIS	0	0	1	7
			AMNICOLA	0	1	0	7
			GAMMARUS	0	1	0	7
			PLECOPTERA	0	0	1	7
			POLYCENTROPUS	0	0	1	7
		4	CHIRONOMIDAE	24	30	95	1033
			OLIGOCHAETA	26	39	50	792
			OSTRACODA	1	66	48	792
			ACARINA	1	3	2	41
			AMNICOLA	0	4	0	28
			CAENIS	1	2	0	21
			ANCYLIDAE	0	1	2	21
			RHABDOCOELA	1	1	1	21
			EMPIDIDAE	0	1	1	14
			HYALELLA AZTECA	1	1	0	14
			PISIDIUM	0	1	1	14
			OECETIS	0	2	0	14
			GAMMARUS	1	0	0	7
			HYDRA	0	1	0	7
			LEPTOCERIDAE	0	1	0	7
			GYRAULUS	0	1	0	7
			TIPULIDAE	0	1	0	7
	IV	1	HYDRA	28	4	2	234
			CHIRONOMIDAE	7	2	0	62
			ACARINA	2	0	0	14
			CAENIS	1	0	0	7
			NEMATODA	1	0	0	7
			OLIGOCHAETA	1	0	0	7
			OSTRACODA	1	0	0	7
		2	CHIRONOMIDAE	2	9	0	76
			OLIGOCHAETA	1	2	0	21
		3	CHIRONOMIDAE	18	4	2	165
			OLIGOCHAETA	2	4	1	49
			PONTOPOREIA HOYI	0	2	0	14
			CAENIS	0	0	1	7
			OECETIS	1	0	0	7
		4	OLIGOCHAETA	55	31	26	77[illegible]
			CHIRONOMIDAE	16	1	5	152
			NEMATODA	0	1	0	7
			MOLANNA	0	1	0	7
			RHABDOCOELA	1	0	0	7

DATE	TRANSECT	STATION	TAXON	GRAB COUNTS			MEAN NO. /SQ.M
10/ 5/81	V	1	CHIRONOMIDAE	1	0	2	21
			LYMNAEA	1	0	0	7
			NEMATODA	0	0	1	7
		2	PONTOPOREIA HOYI	2	1	0	21
			CHIRONOMIDAE	1	0	1	14
		3	CHIRONOMIDAE	3	7	6	110
			OLIGOCHAETA	2	4	4	69
			PONTOPOREIA HOYI	2	3	0	34
			ACARINA	0	1	0	7
		4	OLIGOCHAETA	95	233	363	4759
			CHIRONOMIDAE	23	15	18	386
			NEMATODA	0	1	2	21
			ACARINA	0	1	1	14
			RHABDOCOELA	1	0	1	14
			HIRUDINEA	0	0	1	7
			OECETIS	0	1	0	7
			HYALELLA AZTECA	0	1	0	7
			HYDRA	1	0	0	7
	VI	1	GAMMARUS	0	0	1	7
		2	CHIRONOMIDAE	4	0	4	55
			OLIGOCHAETA	1	0	1	14
			ACARINA	1	0	0	7
			PHYSA	1	0	0	7
			PONTOPOREIA HOYI	0	1	0	7
		3	CHIRONOMIDAE	13	2	9	165
			OLIGOCHAETA	6	0	1	45
			PONTOPOREIA HOYI	1	2	1	28
			GAMMARUS	0	1	0	7
			HYDRA	0	0	1	7
		4	OLIGOCHAETA	5	7	132	992
			CHIRONOMIDAE	4	15	36	379
			AMNICOLA	2	7	4	90
			HYALELLA AZTECA	1	4	0	34
			NEMATODA	0	1	3	28
			PISIDIUM	1	1	2	28
			OECETIS	2	0	1	21
			RHABDOCOELA	0	0	3	21
			CAENIS	1	0	1	14
			HEXAGENIA	0	0	2	14
			PONTOPOREIA HOYI	0	0	1	7
			ACARINA	0	0	1	7
			STENONEMA	0	1	0	7

APPENDIX D

FISH DATA (GILLNET)

DATE	TRANSECT	STATION	SPECIES	TOTAL NO.	TOTAL WEIGHT (G)	LENGTH RANGE (MM)
6/10/80	I	3	ALEWIFE	30	1225	162-202
			BURBOT	1	1300	512
			TROUT PERCH	21	245	108-122
			LAKE TROUT	1	4050	705
			WHITE SUCKER	6	3690	300-488
			SPOTTAIL SHINER	47	550	100-127
			YELLOW PERCH	5	1140	203-324
		4	ALEWIFE	94	3730	146-208
			RAINBOW SMELT	1	12	187
			TROUT PERCH	14	145	106-125
			CHINOOK SALMON	1	500	388
			LAKE TROUT	1	2650	652
			WHITE SUCKER	1	900	446
			SPOTTAIL SHINER	36	375	102-129
			YELLOW PERCH	12	1613	158-344
	IV	3	ALEWIFE	71	2762	153-195
			TROUT PERCH	19	250	106-125
			LAKE TROUT	3	5950	603-885
			WHITE SUCKER	3	1700	275-448
			SPOTTAIL SHINER	40	455	100-123
			WALLEYE	6	3075	345-392
		4	ALEWIFE	22	954	160-227
			RAINBOW SMELT	2	25	135-156
			TROUT PERCH	28	310	101-127
			SPOTTAIL SHINER	30	365	101-127
			YELLOW PERCH	6	450	146-230
			WALLEYE	1	1250	497
	VI	3	ALEWIFE	48	2317	162-218
			TROUT PERCH	47	667	106-142
			WHITE SUCKER	1	1150	471
			SPOTTAIL SHINER	124	1560	102-125
			YELLOW PERCH	1	72	197
			WALLEYE	4	1700	324-376
		4	LAKE STURGEON	1	600	468
			ALEWIFE	24	1114	155-205
			RAINBOW SMELT	1	28	166
			TROUT PERCH	12	148	108-128
			WHITE SUCKER	1	1050	460
			SPOTTAIL SHINER	19	263	103-126
			YELLOW PERCH	1	600	343
			WALLEYE	2	1525	405-426
7/23/80	I	3	ALEWIFE	102	3358	113-205
			TROUT PERCH	15	190	107-127
			WHITE SUCKER	2	1530	377-482
			SPOTTAIL SHINER	4	158	108-119
			YELLOW PERCH	3	549	228-267
			WALLEYE	1	920	493
		4	ALEWIFE	2[illegible]	925	153-195
			TROUT PERCH	2	30	113-122
			WHITE SUCKER	2	770	266-382
			SPOTTAIL SHINER	4	60	111-118
			YELLOW PERCH	9	1946	143-357
			WALLEYE	1	586	401
	IV	3	ALEWIFE	33	1125	154-191
			CHANNEL CATFISH	1	280	320
			TROUT PERCH	7	80	111-124
			SPOTTAIL SHINER	3	40	106-121
			YELLOW PERCH	6	585	155-246
			WALLEYE	2	780	363-372
		4	ALEWIFE	24	770	151-182
			SPOTTAIL SHINER	2	30	120-128
			YELLOW PERCH	15	1508	142-230
			WALLEYE	3	1376	329-437
	VI	3	ALEWIFE	59	2140	146-197
			BLACK BULLHEAD	1	90	170
			CHANNEL CATFISH	1	330	333
			BROWN TROUT	1	5300	713
			WHITE SUCKER	3	1135	230-361
			SPOTTAIL SHINER	5	50	107-118
			YELLOW PERCH	8	825	166-234
			WALLEYE	8	7570	355-572
		4	ALEWIFE	30	1005	149-190
			TROUT PERCH	3	45	107-122
			WHITE SUCKER	1	880	426
			SPOTTAIL SHINER	4	60	114-127
			YELLOW PERCH	20	3233	102-373
			WALLEYE	1	390	353

DATE	TRANSECT	STATION	SPECIES	TOTAL NO.	TOTAL WEIGHT (G)	LENGTH RANGE (MM)
10/19/80	I	3.	LAKE TROUT	15	43200	582-735
			SPOTTAIL SHINER	4	50	110-125
		4	LAKE TROUT	4	12675	650-725
			WHITE SUCKER	3	1740	281-420
			SPOTTAIL SHINER	1	10	102
			YELLOW PERCH	3	670	192-315
	IV	3	LAKE TROUT	13	41700	595-755
			SPOTTAIL SHINER	5	60	104-115
		4	LAKE TROUT	11	28400	546-710
			SPOTTAIL SHINER	2	25	112-118
	VI	3	LAKE TROUT	1	3800	750
			SPOTTAIL SHINER	2	30	108-113
		4	LAKE TROUT	1	3300	690
			WHITE SUCKER	1	160	250
			SPOTTAIL SHINER	15	178	102-120
			YELLOW PERCH	3	268	182-202
6/10/81	I	3	ALEWIFE	12	500	174-198
			RAINBOW SMELT	7	200	164-180
			TROUT PERCH	4	50	112-125
			SPOTTAIL SHINER	8	100	109-120
			YELLOW PERCH	17	3000	144-340
		4	ALEWIFE	10	445	158-187
			RAINBOW SMELT	4	150	156-179
			TROUT PERCH	3	50	110-124
			ROUND WHITEFISH	1	50	176
			WHITE SUCKER	2	2150	337-520
			SPOTTAIL SHINER	12	200	107-122
			YELLOW PERCH	23	3400	142-265
	IV	3	ALEWIFE	168	5950	162-195
			RAINBOW SMELT	1	22	162
			CHANNEL CATFISH	1	300	345
			TROUT PERCH	12	150	102-122
			WHITE SUCKER	5	3725	371-440
			SPOTTAIL SHINER	40	560	94-124
			WALLEYE	1	500	360
		4	ALEWIFE	2	100	177-180
			RAINBOW SMELT	1	50	205
			TROUT PERCH	18	300	101-130
			SPOTTAIL SHINER	19	250	105-120
			YELLOW PERCH	8	2950	196-348
			WALLEYE	1	400	337
	VI	3	ALEWIFE	200	7000	160-193
			TROUT PERCH	4	50	117-132
			SPOTTAIL SHINER	32	410	105-121
			YELLOW PERCH	3	863	185-337
		4	ALEWIFE	39	1550	162-194
			RAINBOW SMELT	1	20	159
			TROUT PERCH	9	125	111-131
			SPOTTAIL SHINER	17	230	108-125
			YELLOW PERCH	4	605	196-256

DATE	TRANSECT	STATION	SPECIES	TOTAL NO.	TOTAL WEIGHT (G)	LENGTH RANGE (MM)
7/15/81	I	3	ALEWIFE	29	1125	148-189
			WHITE SUCKER	2	750	337-346
			SPOTTAIL SHINER	4	50	111-117
			YELLOW PERCH	4	870	235-274
			WALLEYE	6	5950	340-655
		4	ALEWIFE	23	850	140-201
			WHITE SUCKER	4	1370	275-310
			SPOTTAIL SHINER	3	30	115-123
			YELLOW PERCH	8	2320	165-340
	IV	3	ALEWIFE	6	170	160-173
			WHITE SUCKER	1	650	385
			SPOTTAIL SHINER	1	15	110
			YELLOW PERCH	3	555	142-231
			WALLEYE	7	1920	259-360
		4	ALEWIFE	12	350	157-186
			WHITE SUCKER	2	480	74-360
			SPOTTAIL SHINER	2	20	115-117
			YELLOW PERCH	3	300	170-200
			WALLEYE	6	2250	312-470
	VI	3	ALEWIFE	27	820	103-181
			SPOTTAIL SHINER	4	40	113-118
			YELLOW PERCH	7	1500	145-294
			WALLEYE	3	1750	323-439
		4	ALEWIFE	24	856	144-189
			WHITE SUCKER	5	2950	345-411
			SPOTTAIL SHINER	5	40	112-133
			YELLOW PERCH	1	55	174
			WALLEYE	5	3115	323-479
10/ 6/81	I	3	BURBOT	1	1500	585
			TROUT PERCH	1	5	102
			CHINOOK SALMON	1	4900	770
			LAKE TROUT	7	24850	620-785
			COHO SALMON	1	750	380
			WHITE SUCKER	1	700	375
			ROCKBASS	1	210	212
		4	RAINBOW SMELT	2	30	150-180
			LAKE TROUT	4	15650	740-774
			WHITE SUCKER	2	515	220-330
			SPOTTAIL SHINER	2	20	110-120
	IV	3	LAKE TROUT	6	24700	697-779
		4	LAKE TROUT	6	22200	605-775
			WHITE SUCKER	1	950	425
			WALLEYE	2	500	295-298
	VI	3	GIZZARD SHAD	1	110	203
			TROUT PERCH	1	10	107
			LAKE TROUT	7	22450	594-730
			UNIDENTIFIED REDHORSE	1	850	419
		4	RAINBOW SMELT	1	5	110
			BURBOT	1	1300	567
			CHINOOK SALMON	1	7800	891
			SPOTTAIL SHINER	1	10	110
			WALLEYE	2	1280	302-476

APPENDIX E

FISH DATA (BEACH SEINE)

DATE	TRANSECT	STATION	SPECIES	TOTAL NO.	TOTAL WEIGHT (G)	LENGTH RANGE (MM)
6/12/80	I	1	ALEWIFE	2	******* 1/	***
			RAINBOW SMELT	2	3	62- 75
			TROUT PERCH	51	579	78-128
			CHINOOK SALMON	8	27	70- 79
			CARP	1	1725	485
			WHITE SUCKER	3	1605	361-388
			EMERALD SHINER	106	280	45-105
			SPOTTAIL SHINER	91	653	50-116
			SAND SHINER	107	163	47- 70
			FLATHEAD MINNOW	2	3	44- 53
			LONGNOSE DACE	5	17	66- 80
			MOTTLED SCULPIN	2	3	48
	IV	1	ALEWIFE	33	1275	162-195
			RAINBOW SMELT	2	2	49- 56
			TROUT PERCH	132	1266	64-130
			CHINOOK SALMON	1	1	74
			CARP	1	3700	637
			WHITE SUCKER	1	825	428
			EMERALD SHINER	11	37	66- 94
			SPOTTAIL SHINER	116	999	80-118
			SAND SHINER	2	3	58- 63
			LONGNOSE DACE	23	71	54- 92
	VI	1	ALEWIFE	14	*******	81-185
			RAINBOW SMELT	1	1	53
			TROUT PERCH	33	318	69-134
			FRESHWATER DRUM	1	258	300
			CARP	2	4915	505-570
			EMERALD SHINER	13	32	62- 92
			SPOTTAIL SHINER	30	176	41-132
			SAND SHINER	1	1	52
7/24/80	I	1	ALEWIFE	2	32	52- 83
			TROUT PERCH	107	757	44-124
			CARP	1	3300	603
			EMERALD SHINER	53	163	59- 91
			SPOTTAIL SHINER	130	767	46-117
			SAND SHINER	23	42	54- 74
			LONGNOSE DACE	6	13	53- 79
	IV	1	ALEWIFE	4	90	84-187
			TROUT PERCH	144	948	63-129
			EMERALD SHINER	4	16	72- 94
			SPOTTAIL SHINER	223	1701	56-113
			LONGNOSE DACE	23	61	53- 86
			JOHNNY DARTER	1	*******	41
			LOGPERCH	2	*******	67- 72
			YELLOW PERCH	1	*******	68
	VI	1	ALEWIFE	1	28	157
			RAINBOW SMELT	1	1	31
			TROUT PERCH	144	432	46-110
			WHITE SUCKER	2	720	275-365
			EMERALD SHINER	9	24	71- 95
			SPOTTAIL SHINER	152	1015	42-119
			SAND SHINER	5	11	53- 68
			LOGPERCH	1	4	96
			YELLOW PERCH	10	1204	101-237

1/ * Indicates that no measurements were taken.

DATE	TRANSECT	STATION	SPECIES	TOTAL NO.	TOTAL WEIGHT (G)	LENGTH RANGE (MM)
10/20/80	I	1	GIZZARD SHAD	1328	19175	62-180
			RAINBOW TROUT	1	300	270
			EMERALD SHINER	7	22	69- 85
	IV	1	GIZZARD SHAD	277	1730	60-145
			RAINBOW SMELT	19	14	46- 67
			EMERALD SHINER	8	28	78- 91
			SPOTTAIL SHINER	1	5	87
			SAND SHINER	3	5	52- 62
			LONGNOSE DACE	117	363	41- 91
			LOGPERCH	3	20	91- 92
			RIVER DARTER	3	3	43- 55
			MOTTLED SCULPIN	2	26	37- 77
	VI	1	GIZZARD SHAD	1568	12500	64-172
			RAINBOW SMELT	8	5	44- 64
			LAKE TROUT	1	2000	590
			EMERALD SHINER	1	4	89
			SPOTTAIL SHINER	4	16	51-113
			MOTTLED SCULPIN	1	4	64
6/10/81	I	1	ALEWIFE	103	3910	74-197
			RAINBOW SMELT	12	280	144-185
			TROUT PERCH	50	515	77-123
			CHINOOK SALMON	14	55	66- 85
			WHITE SUCKER	2	1280	367-419
			EMERALD SHINER	82	420	72-101
			SPOTTAIL SHINER	63	590	80-117
			SAND SHINER	3	4	52- 67
			LONGNOSE DACE	8	16	50- 73
			ROCKBASS	1	280	215
			YELLOW PERCH	1	125	217
	IV	1	ALEWIFE	52	1846	89-199
			TROUT PERCH	284	2459	70-129
			CHINOOK SALMON	2	12	174-176
			EMERALD SHINER	38	175	78-102
			SPOTTAIL SHINER	43	398	80-116
			SAND SHINER	2	2	56- 57
			LONGNOSE DACE	1	5	97
	VI	1	ALEWIFE	79	3195	157-197
			GIZZARD SHAD	1	950	452
			TROUT PERCH	37	318	75-124
			CHINOOK SALMON	16	58	65- 82
			WHITE SUCKER	1	1125	440
			EMERALD SHINER	132	585	73-100
			SPOTTAIL SHINER	144	1270	77-112
			YELLOW PERCH	2	550	239-291
			WALLEYE	1	410	357
			MOTTLED SCULPIN	3	8	47- 57

DATE	TRANSECT	STATION	SPECIES	TOTAL NO.	TOTAL WEIGHT (G)	LENGTH RANGE (MM)
7/15/81	I	1	ALEWIFE	3	107	136-149
			CARP	1	675	675
			EMERALD SHINER	3	20	70-105
			SPOTTAIL SHINER	2	18	88- 92
			LONGNOSE DACE	1	5	66
	IV	1	ALEWIFE	7	148	130-162
			TROUT PERCH	1	8	86
			EMERALD SHINER	1	8	74
			SPOTTAIL SHINER	3	22	87- 96
			LONGNOSE DACE	1	9	90
	VI	1	TROUT PERCH	6	28	60- 96
			EMERALD SHINER	2	7	68- 74
			SPOTTAIL SHINER	29	217	66-111
			SAND SHINER	1	3	57
			LONGNOSE DACE	1	3	58
			MOTTLED SCULPIN	1	5	59
11/12/81	I	1	GIZZARD SHAD	6	95	88-168
			SPOTTAIL SHINER	1	18	106
			SAND SHINER	13	20	34- 68
			BLUNTNOSE MINNOW	2	6	51- 70
			LONGNOSE DACE	2	5	67- 68
			MOTTLED SCULPIN	1	2	40
	IV	1	GIZZARD SHAD	7	85	87-127
			RAINBOW SMELT	1	7	108
			EMERALD SHINER	8	20	42- 93
			MOTTLED SCULPIN	1	5	66
	VI	1	GIZZARD SHAD	10	78	76-122
			RAINBOW SMELT	1	8	117
			EMERALD SHINER	1	2	56
			SAND SHINER	8	10	53- 65

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